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OLUME 59

# PHYSICS ABSTRACTS

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# Physics Abstracts

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The monthly Author Index, List of Journals, Errata and Notes follow immediately after the last page of abstracts.

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Automatic control mechanisms
Applied electrochemistry
Lines and networks
Waveguides
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
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# PHYSICS ABSTRACTS

Volume 59 JULY 1956 Number 703

## MATHEMATICS 51

512.25 : 518.12

4768. THE SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS BY MATRIX ITERATION. J.Guest.
Austral. J. Phys., Vol. 8, No. 4, 425-39 (Dec., 1955).

In a recent paper Stiefel presented a method designed for a high-speed computer, for solving simultaneous linear algebraic equations of the type

$$\sum_{k=1}^{n} a_{ik}u_k + l_i = 0, \quad i = 1, 2, 3, \ldots, n.$$

The method proposed here arose from that paper. Moreover, since Stiefel fully examined the symmetric case, $a_{ik} = a_{ki}$, it seemed natural to develop the present theory for non-symmetric matrices also. Actually, Stiefel and Hestenes also touched on the non-symmetric problem but did not pursue the subject very far. A comparison between their method and that proposed here is given. As in Stiefel's theory the iteration ends at step n, which actually represents the exact solution provided no rounding-off errors have been committed. However, a different type of orthogonality and conjugate relation is used here as both D (i.e. the matrix $[a_{ik}]$) and its transpose D* are operated with simultaneously. Formulae have been found for the characteristic polynomial of D and for its inverse.
A.

517.532

4769. ON A REGULAR CAUCHY PROBLEM FOR THE EULER–POISSON–DARBOUX EQUATION. E.T.Copson.
Proc. Roy. Soc. A, Vol. 235, 560-72 (June 19, 1956).

A new method is given for solving the wave equation in space of any odd number of dimensions without making use of any device for evaluating divergent integrals. This gives the clue to a simple method of solving the regular Cauchy problem for the so-called Euler–Poisson–Darboux equation in space of any odd number of dimensions, a problem which has previously only been solved by a very difficult extension of Marcel Riesz's method.
A.

518.2

4770. RECTANGULAR-POLAR CONVERSION TABLES. Compiled by E.H.Neville.
London: The Cambridge University Press (1956) xxxii + 109 pp. (Royal Society Mathematical Tables Volume 2).

Values of the argument r, ln r and the modulus $\theta$ are given to 15 decimal places (the latter in degrees and in radians) for values of the Cartesian co-ordinates x and y between 1 and 105 in steps of 1. The introduction describes the method of interpolation to be used, for which supplementary tables are provided.

518.42

4771. THE SMOOTHING OF UNFORMULATED EXPERIMENTAL LAWS BY AN AVERAGING OPERATION WHICH DOES NOT INTRODUCE ANY ARTIFICIAL CONFUSION. P.Vernotte.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1697-9 (March 26, 1956). In French.

See Abstr. 8435 (1951), 7617 (1955). A section of the experimental curve containing M points is represented by a quadratic $(Ax^2 + Bx + C)$ and using the author's methods to calculate A, B and C so that the imprecisions of the measurements have least effect, the "most determined" ordinate in the neighbourhood of M/3 is obtained. The method avoids the apparent oscillation about the mean of other methods of averaging.
S.Weintroub

518.5

4772. INVESTIGATIONS OF RAPIDLY CONVERGING PERTURBATION METHODS SUITABLE FOR PROGRAMMING ON PUNCHED-CARD ELECTRONIC MACHINES. J.L.Masse.
J. Rech. Cent. Nat. Rech. Sci., Vol. 6, No. 33, 393-403 (Dec., 1955). In French.

Programming and convergence difficulties of perturbation methods for solution of eigenvalue problems are outlined. New iterative procedures are developed, convergence being studied in detail. In a numerical example, eigenvalues obtained with different iterations are plotted.
N.M.King

518.5 : 681.142 : 621.385.1.029.5

4773. THE HYPERBOLIC FIELD TUBE, AN ELECTRON-BEAM TUBE AS THE MULTIPLIER IN AN ANALOGUE COMPUTER. W.Schmidt.
Z. angew. Phys., Vol. 8, No. 2, 69-75 (1956). In German.

Describes the construction and method of operation of a tube in which the deflection of an electron beam after passing through two deflecting systems is proportional to the product of the voltage on these systems. A voltage proportional to the deflection is fed back from a split anode to a third deflecting system so that the beam stays almost central on the anode. The voltage on the third system is taken as the output from the tube. The error is given as 0.5% and the upper limit of frequency as above 200 kc/s.
J.Dutton

# ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.11

4774. ANISOTROPIC MODELS IN NEWTONIAN COSMOLOGY. III. F.Zagar.
R.C. Accad. Naz. Lincei, Vol. 19, No. 5, 217-21 (Nov., 1955). In Italian.

For Pt II see Abstr. 871 (1956). The various possible models are classified as elliptic, parabolic and hyperbolic, and the corresponding velocity fields are discussed.

R.A.Newing

523.161

4775. THE PROPORTION OF H I TO Na, Ca, AND DUST IN INTERSTELLAR SPACE. H.Lambrecht and K.H.Schmidt.
Naturwissenschaften, Vol. 43, No. 4, 78-9 (1956). In German.

Using the experimental data of Van de Hulst, Muller and Oort (1954) for H I concentration in the galactic plane, and for interstellar Na I and Ca II, Lambrecht and Weigert (1955), the following relations are found:

$$N_{Na\,I} = (2.6 \pm 1.0) \times 10^{-7}\, N_{H\,I}^{0.92 \pm 0.20}$$

$$N_{Ca\,II} = (3.6 \pm 1.5) \times 10^{-8}\, N_{H\,I}^{0.86 \pm 0.35}$$

The number-density ratios for absorbing atoms of Na to H, and Ca to H respectively are $5 \times 10^{-9}$ and $3 \times 10^{-9}$. The mean ratio, H I/dust = 275, as derived from the relation between colour-excess and H I, is about 3 times larger than that observed from a comparison of 21 cm line-intensities with interstellar reddening.

D.R.Barber

523.162.1

4776. ON INTERSTELLAR POLARIZATION. A.Martini and A.Masani.
Mem. Soc. Astron. Ital., Vol. 26, No. 4, 523-8 (1955). In Italian.

The measurements of H.S.Hall and of W.A.Hiltner (1951) are used to compare the polarizations of light from stars situated in H I and H II regions. It is concluded that the results support the Davis–Greenstein rather than the Spitzer–Tukey theory (1951).

R.A.Newing

523.164.32

4777. THE DISTRIBUTION OF RADIO BRIGHTNESS OVER THE SOLAR DISK AT A WAVELENGTH OF 21 CENTIMETRES. III. THE QUIET SUN — TWO-DIMENSIONAL OBSERVATIONS. W.N.Christiansen and J.A.Warburton.
Austral. J. Phys., Vol. 8, No. 4, 474-86 (Dec., 1955).

For Pt II, see Abstr. 19 (1954). A distribution of solar radio brightness at a wavelength of 21 cm has been derived from observations made during the period of low sunspot activity from 1951 to 1954. The observations were made using two multiple interferometers arranged at right angles; this enabled the solar disk to be scanned in many different directions. The derived one-dimensional profiles of the quiet sun for these various scanning directions were combined and a Fourier method adopted to derive a two-dimensional brightness distribution. The distribution shows marked limb-brightening in the equatorial zones but none in the polar regions. The contours of brightness are in general conformity with those expected from a solar atmosphere having a coronal electron density distribution of the kind proposed by van de Hulst for the period of minimum sunspot activity.

A.

523.164.32

4778. SOLAR BRIGHTNESS DISTRIBUTION AT A WAVELENGTH OF 60 CENTIMETRES. I. THE QUIET SUN.
G.Swarup and R.Parthasarathy.
Austral. J. Phys., Vol. 8, No. 4, 487-97 (Dec., 1955).

A multiple-element interferometer has been employed to determine one-dimensional distributions of radio brightness over the quiet sun at a wavelength of 69 cm for scanning dir tions varying from 90° to 60° with respect to the central me dian of the sun. These observations have been compared wi measurements by other workers at the same, or nearly the same, wavelength. The present observations are reasonabl consistent with the two-dimensional brightness distribution derived recently by O'Brien and Tandberg-Hanssen with a t aerial interferometer, but do not agree with the earlier res of Stanier at the same wavelength. The disagreement, larg the absence of the theoretically predicted limb-brightening Stanier's results, may reflect actual changes in the sun ove the solar cycle. However, the possibility of localized distu regions affecting Stanier's results for the quiet sun cannot b eliminated.

523.164.

4779. APPARENT INTENSITY VARIATIONS OF THE RA SOURCE HYDRA-A. O.B.Slee.
Austral. J. Phys., Vol. 8, No. 4, 498-507 (Dec., 1955).

Describes the results of a detailed study of the flux den of the discrete radio source, Hydra-A. Over a period of 12 months, approximately 200 measurements of the Hydra-A i tensity were compared with a similar number of observatio on other strong sources. It was concluded that the observed flux density of Hydra-A is much more variable than that of these other sources, although no periodic changes have yet detected. Possible mechanisms for the observed intensity changes are discussed.

523.164.

4780. ROTATION AND OTHER MOTIONS OF THE MAGE LANIC CLOUDS FROM RADIO OBSERVATIONS. F.J.Kerr and G. de Vaucouleurs.
Austral. J. Phys., Vol. 8, No. 4, 508-22 (Dec., 1955).

The radial velocities measured in a survey of the 21 cm line from the Magellanic Clouds are discussed, principally terms of the median velocity for each line profile. It is sho that each Cloud is rotating, and the analysis confirms the vi based on optical evidence, that the Clouds are flattened and tilted systems. The gas is probably the least flattened const tuent of each Cloud and shows a large decrease of rotational speed with increasing distance from the equatorial plane. T radial velocities of the Large and Small Clouds with respect to the Sun, weighted according to the 21 cm surface brightne are found to be + 280 and + 161 km/sec. Other internal motio both systematic and random, are also indicated by the profil

523.51 : 539.155

4781. MEANING OF DEUTERIUM ABUNDANCE IN METEORITES. G.Boato.
Nature (London), Vol. 177, 424-5 (March 3, 1956).

See Abstr. 8450 (1955). Discusses the criticism of the author's work made by Edwards and in particular justifies the accuracy of the analytical data and the special significan given to four results which show a D/H ratio outside the nor terrestrial variations.

J.M.Hou

523.7

4782. POWERFUL SOLAR EMISSION OF COSMIC RADIATION AT NIGHT. A.Dauvillier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1399-401 (March 1956). In French.

An exceptionally sharp and intense burst of cosmic radi tion lasting approximately thirty minutes was observed at Bagnères (550 m above sea level) on 23 Feb., 1956, commen ing at 3.43 G.M.T. The burst was observed using three inde pendent methods of recording and was of unprecedented inten sity.

A.J.Egginto

523.72 : 537.591.5

4783. EXCEPTIONAL PERTURBATION OF SOLAR RADIATION OF FEBRUARY 23RD, 1956 AT ABOUT 3.45 G.M.T. R.Bureau and M.Bertrand.
C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 2025-7 (April 16, 1956). In French.

Rapid fluctuations of exceptional intensity of cosmic radiation were observed at Tokyo, Mitaka and the Kerguelen Islands, an increase of mesons at Weizenau, and of neutrons at Göttingen, and a calm followed by a magnetic storm at Chambon-la-Forêt. The registrations at Bagneux and Poitiers for 11 km and other wavelengths indicate that (1) the increase of cosmic radiation produces a considerable lowering of propagation for wavelengths 24 km to 20m, and especially at 11 km, but waves of greater wavelength are practically unaffected, (2) the phenomenon is relatively localized, (3) synchronism between the initial phenomenon and its reactions are almost perfect, producing an increase in the illuminated hemisphere and a smaller fall in the night hemisphere. R.S.Read

523.74

4784. ON THE VARIABILITY OF THE SOLAR RADIUS M.A.Giannuzzi.
R.C. Accad. Naz. Lincei, Vol. 19, No. 5, 277-82 (Nov., 1955). In Italian.

An analysis of Greenwich measurements of the solar diameter from 1851 to 1937 confirms the existence of a primary oscillation of period 22-23 years. Differences in the secondary oscillations derived from Greenwich and Rome observations are attributed to atmospheric effects. R.A.Newing

523.76

4785. THE TREND OF TEMPERATURE IN THE OUTER PHOTOSPHERIC LAYERS OF THE SUN. H.Neckel.
Naturwissenschaftem, Vol. 43, No. 7, 152 (1956). In German.

A plot of temperature, $\theta$, versus optical depth, $\tau$, at 5010 A reveals a discontinuity (at $\theta$ = 5000 K, $\tau$ = 0.015) connecting two approximately linear portions with very different slopes; that representing the range of optical depth, 0.015 to 0.20, being much less steep than that covering near-surface values of $\tau$. D.R.Barber

523.775

4786. SPECTROPHOTOMETRY OF INTENSE EMISSION LINES IN THE SOLAR CHROMOSPHERE. R.Michard and J.Laborde.
C.R.C.Accad. Naz. Lincei, Vol. 19, No. 5, 283-91 (Nov.,1955). In French.

Photographic spectrophotometry (at high dispersion, 1.3 A/mm at H$\alpha$) of the chromospheric emission gave the following results: (i), for isolated spicules in the height-range, 4200 to 6200 km, H$\alpha$ has a mean width of 0.7 A, and shows Doppler displacements of from 0.50 to 0.75 A; (ii), in the lower chromosphere H$\alpha$ is influenced by auto-absorption, and it is noted that the ascending spicules are brighter than those which descend, (iii), in the higher regions, a lesser intensity of H$\alpha$ results from an actual decrease in the number of spicules in the line of sight, rather than from a lowered luminosity of individual spicules; (iv), the He emission at 3876 A is not emitted by spicules, but originates in the chromospheric regions between these. D.R.Barber

523.854.1

4787. CORRELATION PROBLEMS IN THE STUDY OF THE BRIGHTNESS OF THE MILKY WAY. A.Ramakrishnan and S.K.Srinivasan.
Astrophys. J., Vol.123, No. 3, 479-85 (May, 1956).

The problem of the fluctuations in the brightness of the Milky Way is studied from a new point of view — the correlation between the contributions to brightness from different parts of the astrophysical system. Besides extending the results obtained by Münch, this paper points out the relevance to the phenomenological theory of stochastic integration recently developed by one of the authors. A.

523.872

4788. POLARIZATION OF THE CRAB NEBULA. M.T.Martel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1847-9 (April 9, 1956). In French.

Photographic measurements made with an Öhman polarimeter in 12 regions of the nebula, each 8" of arc in diameter, reveal polarizations of from 6% to 45% which are identical (to within ± 1%) in each of the two spectral regions: 4000-5000 A and 5200-5800 A. The direction of the plane of polarization follows approximately that of "Baade's filaments" (1956). D.R.Barber

523.874

4789. PROPORTIONALITY OF NEBULAR RED SHIFTS TO WAVE LENGTH. R.Minkowski and O.C.Wilson.
Astrophys. J., Vol. 123, No. 3, 373-6 (May, 1956).

Measures of the red shift $c\delta\lambda/\lambda_0$ for the colliding galaxies Cygnus A give the value 16812 ± 9 km/sec for the mean wave length 3830 A and 16798 ± 7 km/sec for the mean wave length 6472 A. The relative change in the red shift with wave length is less than $3 \times 10^{-4}$ per 1000 A. Combination of the optical results with those by Lilley and McClain for the 21 cm hydrogen line shows that the relative change is less than $3 \times 10^{-9}$ per 1000 A. A.

523.877

4790. STELLAR MODELS BASED ON THE PROTON–PROTON REACTION. P.Naur.
K. Danske Vidensk. Selsk., mat.-fys. Medd.,Vol. 30, Paper 16, 49 pp. (1956).

Using punched-card equipment to solve the differential equations, twenty different stellar opacity laws have been examined, and detailed results, based on the general equation, $\chi = \chi_0 \rho^{1-\alpha} T^{-3-s}$, are tabulated for eleven models with parameter values ranging from $\alpha$ = 0.0 to +1.0, and s = +0.5 to −3.0. Results for H–He stars agree with those obtained independently by Reiz (1954), based on the opacity law, $\chi = \chi_0 \rho^{0.5} T^{-1.75}$. D.R.Barber

525.35

4791. POLAR WANDERING: A MARATHON OF ERRORS. W.H.Munk.
Nature (London), Vol. 177, 551-4 (March 24, 1956).

Reference is made first to Darwin's paper of 1877 "On the influence of geological changes on the earth's axis of rotation", in which a solution was sought for a rigid or plastic earth and the corresponding motion of the pole. The argument for a rigid earth was subsequently shown to be in error and withdrawn. Kelvin sought to show that the geological hypothesis of a thin rigid shell was in error, but this fails if the mantle behaves as an elastic solid to disturbances of short period but flows with stress of long duration. Kelvin in 1890 considered the earth divided into four quadrants having respective rises and falls, with an equatorial bulge, and the resulting polar wandering. Jeffreys corrected an error in Darwin's original solution and thus proved no polar wandering for a fluid earth but the author obtains substantial polar wandering with surprisingly small continental upheavals in agreement with Gold. The many papers centred on Darwin's paper are mentioned, with geologists and biologists believing in polar wandering, and recent palaeomagnetic evidence confirming it. R.S.Read

# PHYSICS 53

53

4792. MODERN PHYSICS. J.C.Slater.
New York: McGraw-Hill Book Company (1955) 322 pp.
Review in Amer. J. Phys., Vol. 24, No. 4, 289 (April, 1956). ".... the aim is to provide a broad perspective, emphasizing how the major concepts have gradually taken form".

53

4793. MODERN PHYSICS. A TEXTBOOK FOR ENGINEERS. R.L.Sproull.
New York: John Wiley and Sons; London: Chapman and Hall (1956) xii + 491 pp.
The book is based on a one-semester course in atomic, solid-state, and nuclear physics, for engineering undergraduates, as taught at Cornell since 1950. It provides an analytical introduction to modern physics and its applications.

53 : 54

4794. HANDBOOK OF CHEMISTRY AND PHYSICS.
Edited by C.D.Hodgman, R.C.Weast and S.M.Selby.
Thirty-seventh ed., 1955-56. Cleveland, Ohio: Chemical Rubber Publishing Co. xxii + 3156 pp.
This well known handbook gives a very large amount of physical and chemical data, both for pure elements and compounds and for a great variety of technical and commercial materials, as well as mathematical tables, conversion tables for units, formulae, integrals etc. The new edition contains a considerable quantity of revised information, with a number of new tables of data, and some new definitions.

53.082/.089

4795. GENERAL TECHNIQUES OF THE PHYSICS LABORATORY. (Techniques Générales du Laboratoire de Physique). Volume 1. Edited by J.Surugue.
(2nd ed.) Paris: Centre National de la Recherche Scientifique (1955) 671 pp. In French.
This second edition is a revised and expanded version of the earlier edition published in 1947. It consists of ten chapters: "General principles of construction of scientific apparatus" by H.Gondet; "The principal operations of laboratory glassblowing" by C.Amate; "Vacuum technique" by J.Surugue; "The production and measurement of high temperatures" by G.Ribaud and A.Moutet; "General techniques of laboratory optics" by A.Arnulf; "Light sources and filters" by G.Dupuy; "Photoelectric cells" by A.Lallemand and M.Munsch; "Recording" by H.Gondet; "Control and adjustment of voltage and current" by M.Demontvignier; and the new chapter "Amplification and transformation of signals. Technique of electrical circuits and vacuum tubes" by R.Huchet. The text is illustrated by more than 500 line drawings. The bibliographies at the ends of the chapters are inadequate and references, except in one or two isolated cases, are not given. Emphasis is on general principles and fundamentals, and many recent forms of apparatus, e.g. gas-ballast pumps and semiconductors, are not mentioned. A useful laboratory reference book. For accurate work the data given should be checked carefully.
S.Weintroub

53.087.4

4796. ON A VARIABLE-SPEED RECORDER. G.Blet.
J. Phys. Radium, Vol. 16, No. 12, 103S-105S (Dec., 1955). In French.
The principle of such a recorder is considered theoretically and a practical model is described together with specimen results. The value of the recorder for studying experimental characteristics is briefly discussed. G.F.Hodsman

53.08

4797. A SEMI-AUTOMATIC PEN-RECORDER CHART ANALYSER. C.W.Spencer and G.H.Bazzard.
J. sci. Instrum., Vol. 33, No. 6, 228-9 (June, 1956).
A description is given of an instrument which enables a rapid analysis of the variations of displacement of a pen tra upon a moving chart to be made. The pen trace is followed manually by means of a cursor making an electrical connect with a number of fixed contacts, which are in turn connecte through a distribution board to electrically-operated counte A cam-operated make-and-break switch produces the pulse to actuate any particular counter, determined by the positio of the movable contact. The numbers of pulses recorded on the counters are measures of the amounts of time the pen di placement is between pre-selected levels across the chart.

53.088 : 51

A THEORY OF CERTAINTY. APPLICATION TO METI LOGY. See Abstr. 4148

## FUNDAMENTALS 530.1

530

4798. FIFTY YEARS OF RELATIVITY. P.G.Bergmann.
Science, Vol. 123, 487-94 (March 23, 1956).
Review. 44 refs.

530.

4799. APPROXIMATE EQUATIONS OF THE UNIFIED FIELD THEORY OF EINSTEIN–SCHRÖDINGER. M.A.Tonnelat.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 902-20 (May, 1956). In French.
Approximate equations are obtained from rigorous and general solutions $\Gamma^{\rho}_{\mu\nu}(g_{\lambda\epsilon})$ and without any hypotheses about the order of the $\gamma_{\mu\nu} = g_{\mu\nu}$. Some physical interpretations o these results are given. The stress-moment tensor is point out of the equations of gravitation and some possibilities app of obtaining the equations of motion of a charged particle.

530.

4800. THE RELATIVISTIC MECHANICS OF A MATERIA POINT OF VARIABLE MASS. N.S.Kalitsin.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 631-2 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 565-7 (Nov., 1955).
See Abstr. 3458 (1956).

530.

4801. A GENERAL RELATIVITY THEORY OR GRAVITA ION THEORY? M.F.Shirokov.
Zh. éksper teor. Fiz., Vol. 30, No. 1, 180-4 (1956). In Russian.
A discussion paper.

530.1

4802. ON A TENSOR FORMULATION OF SECOND QUANTIZATION. R.Potier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 878-81 (Feb. 13, 1956). In French.
A study of the properties of the tensors introduced in th author's formulation of second quantization (Abstr. 3475/195
P.T.Matthew

530.145

4803. QUANTIZATION OF NON-LINEAR FIELDS. K.Gotō.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 533-50 (March, 1956).

A method of developing quantized non-linear field theories is proposed in the functional representation, where the non-linearity of the classical equation appears as the peculiar form of field operators and the field equation for state vectors becomes a linear functional differential equation. The method to diagonalize the field Hamiltonian is illustrated by the free electromagnetic field, the hydrodynamical field and the non-linear meson field. A.

530.145

4804. SUPPLEMENTARY CONDITION OF THE STÜCKELBERG FIELD. P.Bocchieri and A.Loinger.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 626-32 (March, 1956). In Italian.

The conventional supplementary condition of the Stückelberg field leads to difficulties similar to those given in electrodynamics by the Fermi condition. With the introduction of an indefinite metric such difficulties are completely avoided. The behaviour of the complex field is remarkable: the supplementary condition remains formally unchanged. A.

530.145

4805. CHARGE RENORMALIZATION GROUP IN QUANTUM FIELD THEORY. N.N.Bogoljubov and D.V.Širkov.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 845-63 (May, 1956).

Lie differential equations are obtained for the multiplicative charge renormalization group in quantum electrodynamics and in pseudoscalar meson theory with two coupling constants. By the employment of these equations the asymptotic expressions have been found for the electrodynamical propagation functions in the "ultraviolet" and in the "infrared" regions. The asymptotic high momenta behaviour of meson theory propagation functions is also discussed, for the weak coupling case. A.

530.145

4806. MULTIPLICATIVE RENORMALIZATION GROUP IN QUANTUM FIELD THEORY. N.N.Bogolyubov and D.V.Shirkov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 77-86 (1956). In Russian.

Lie differential equations for the multiplicative renormalization group of quantum field theory are presented. As an illustration of application of the equations spinor electrodynamics Green's functions have been determined in the ultraviolet and infrared catastrophe regions. A.

530.145

4807. A REMARK ON QUANTUM ELECTRODYNAMICS WITH NON-VANISHING PHOTON MASS AND LAMB SHIFT CALCULATIONS. B.Nagel.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 496-8 (Feb., 1956).

Longitudinal mesons give a non-vanishing contribution to the cross-section for bremsstrahlung with emission of soft mesons. G.E.Brown

530.145 : 538.565 : 621.373.42

4808. EXACT QUANTUM THEORY SOLUTION FOR THE DAMPED HARMONIC OSCILLATOR. J.Weber.
Phys. Rev., Vol. 101, No. 6, 1619-20(March 15, 1956).

It is shown that the perturbation theory solution previously given (Abstr. 6460/1953) for the damped harmonic oscillator is exact. The expression given for the conductance is also exact. A.

530.145

4809. VERTEX PARTS FOR VERY HIGH ENERGIES IN QUANTUM ELECTRODYNAMICS. V.V.Sudakov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 87-95 (1956). In Russian.

A method of calculation of Feynman integrals with logarithmic accuracy to an arbitrarily high order of perturbation theory has been developed. The method is applied to compute the vertex part in quantum electrodynamics for a certain range of values of the variables, the result being expressed as the sum of the perturbation theory expansion. A.

530.145

4810. BEHAVIOUR OF THE VERTEX PART AT HIGH ENERGIES. V.Z.Blank.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 3, 389-91 (1956). In Russian.

Starting from the integral equations, one obtains the same results as V.V.Sudakov did (in a dissertation) by summing graphs. G.E.Brown

530.145

4811. ON THE INFRARED CATASTROPHE IN QUANTUM ELECTRODYNAMICS. A.A.Abrikosov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 96-108 (1956). In Russian.

The infrared catastrophe has been investigated by diagram summation. Expressions of G(p) for $\frac{e^2}{\pi} \ln \frac{m^2}{p^2-m^2} > \sim 1$ and of $\Gamma_\mu(p, q; l)$ for $(p, q) \gg p^2-m^2$, $q^2-m^2$ are presented. The problem of radiation of additional photons by electrons of arbitrary energy scattered by an external field is also considered. A.

530.145

4812. A POSSIBLE GENERAL SCHEME OF INTERACTIONS BETWEEN ELEMENTARY PARTICLES. F.Duimio.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 595-9 (March, 1956). In Italian.

Starting from an extension of Polkinghorne-Salam's model, in which leptons are included (Abstr. 2653/1956), a scheme is given by which it seems possible to explain qualitatively the decay phenomena of the elementary particles, on the basis of a weak Fermi interaction. A.

530.145

4813. CHARGE CONJUGATION, A NEW QUANTUM NUMBER G, AND SELECTION RULES CONCERNING A NUCLEON-ANTINUCLEON SYSTEM. T.D.Lee and C.N.Yang.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 749-53 (April, 1956).

A new quantum number is introduced which leads to selection rules concerning transitions between states with heavy particle number = 0. They are applied to the system nucleon-antinucleon; it is also shown that they can be extended to include the conservation of strangeness. A.

530.145

4814. HIGH ENERGY BEHAVIOUR OF RENORMALIZABLE FIELDS. H.Umezawa, Y.Tomozawa, M.Konuma and S.Kamefuchi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 772-99 (April, 1956).

It has been suggested that the renormalized value of the coupling constant is sometimes restricted within a zone, i.e. the normal zone. Gell-Mann and Low showed an intimate relation between the renormalization factor and the asymptotic form of the renormalized propagator. By using this relation to calculate the renormalized propagators and the effective couplings, peculiar features are discussed, which appear in results of the renormalization theory in high-energy phenomena when the observed values of the coupling constants are out of the normal zones. The normal zone of the electric charge and the effective charge in the quantum electrodynamics will be discussed in a succeeding paper. A.

530.145

4815. BILOCAL THEORY OF THE INTERACTION OF A PARTICLE WITH SPIN $\frac{1}{2}$ AND THE ELECTROMAGNETIC FIELD. E.Minardi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 968-78 (May, 1956). In Italian.

A bilocal theory is presented for a free particle with spin

½ based on a simple general generalization of the Dirac equation. This equation is resolved introducing a condition for the mass quantization and a new supplementary condition substituting Yukawa's condition used in a preceding paper. The generalization of the theory is such that in the equations the co-ordinates of the observable motion and the internal co-ordinates appear formally symmetric. Then interaction is introduced between the non-quantized bilocal field and the quantized electromagnetic field so as to satisfy symmetry. The theory so obtained is differential and linear; it satisfies gauge invariance and charge conservation, provided one allows for the variation of the four-current due to the internal part of the bilocal field. It is finally shown that the theory leads to the appearance in the interaction matrix elements of factors which cut high pulses in an invariant manner. A.

530.145

4816. ON THE THEORY OF SPIN-TWO PARTICLES. A. da Silveira.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 513-16 (March, 1956).

The gauge transformation of second kind is obtained for the equation of spin-two particles proposed previously (Abstr. 3439/1955). It is found that the Einstein equation coincides with the spin-two equation, in the case of weak gravitational field. A.

530.145

4817. A RELATIVISTIC THEORY OF CHARGED PARTICLES IN AN ELECTROMAGNETIC AND GRAVITATIONAL FIELD. H.T.Flint and E.M.Williamson.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 551-65 (March, 1956).

A theory of charged particles is developed by an extension of Einstein's concept of local axes. A new four vector is added to the geometrical system in addition to the electromagnetic potential vector. The particle is then identified with the geometry and the discussion leads to a relativistic theory of the electron, in which the difficulty concerning the self-energy is avoided. A.

530.145

4818. A MASS SPECTRUM FROM A FIELD THEORY MODEL OF THE NON-LOCAL THEORY. P.Sen.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 612-25 (March, 1956).

A field theory model of Yukawa's non-local theory for the mass spectrum of the elementary particles is built. Corresponding to every spin a wave equation is found whose ground state represents the mass of the stable particle of that spin and its excited states are interpreted as the elementary unstable particles. Allowing for the choice of suitable values for the arbitrary coupling constants, the theory appears to be in reasonable agreement with the general features of the mass spectrum and gives the mass 2247 $m_e$ for $\Lambda^{+,0,-}$ particles of spin $\frac{1}{2}$. Particles of spin 0 and masses 1640 $m_e$, 2287 $m_e$ and spin $\frac{1}{2}$ and mass 1758 $m_e$ are also found. In order to obtain the mass spectrum several approximations are found necessary and it is suggested that provided they are consistent the results might not be very sensitive to the model used for actual calculations. A.

530.145

4819. VARIATIONAL PRINCIPLE IN THE HYDRODYNAMICAL FORMULATION OF THE DIRAC FIELD. T.Takabayasi.
Phys. Rev., Vol. 102, No. 1, 297-8 (April 1, 1956).

The author's formulation of the Dirac field (Abstr. 910/1956) may be derived from a Lagrangian. P.T.Matthews

530.145

4820. THEORY OF ELECTRON FIELD MASS IN THE PRESENCE OF A MEDIUM. A.A.Sokolov and V.N.Tsytovich.
Zh. éksper. teor. Fiz, Vol. 30, No. 1, 136-40 (1956). In Russian.

Field contributions to the electron mass due to an external medium are considered. The electron-positron vacuum is taken into account in the calculations. A.

530.

4821. ON CARRYING OUT A VARIATIONAL PROCEDUR IN A SCALAR FIELD THEORY. K.Meyer.
Ann. Phys. (Leipzig), Vol. 17, No.2-3, 109-14 (1956). In German.

A solution of the equation of a real scalar meson field with scalar coupling to a scalar non-relativistic nucleon fie corresponding to lowest total energy of the system is inves gated. Two approximate solutions of the associated variati problem are obtained and their significance is critically ex amined. H.M

530.1

4822. A STUDY OF NUCLEON FORCES WITH REPULSIV CORES. II. LOW ENERGY PROPERTIES, PARTICULARLY CHARGE INDEPENDENCE. J.Shapiro and M.A.Preston.
Canad. J. Phys., Vol. 34, No. 5, 451-72 (May, 1956).

For Pt I, see Abstr. 8990 (1955). The low energy prop ties of two-nucleon potentials with infinite repulsive cores h been studied by numerical calculations using an electronic digital computer. The consequences of assuming charge inc pendence for the nuclear force in the $^1S$ state have been ex- amined by performing computations with several potential shapes for both the neutron–proton and proton–proton syst It was found that this assumption severely restricts the pos ible potential shape. Charge independence occurs with the Yukawa potential for zero core radius. Potentials that are more singular at small distances than the Yukawa require larger core radii; less singular potentials are not charge i dependent.

530.1

4823. THE PROBLEM OF BOUND STATES AND THE MODEL OF NUCLEON INTERACTIONS WITH MESON PAIR (WENTZEL'S MODEL). E.Arnous.
J. Phys. Radium, Vol. 17, No. 2, 107-11 (Feb., 1956). In French.

Wentzel's model can be treated exactly. When the nucl radius is less than $g^2/4\pi Mc^2$ bound states appear which ma be either physical states (nucleon isobars) or pathological states. The existence of physical bound states depends on the mesonic self-mass of the nucleon. This is not unambig ously determined, but varies with the renormalization procedure used. J.S.B

530.1

4824. ABOUT THE $\Lambda^0$-NUCLEON FORCE. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 499-502 (Feb., 195

The binding energy of a Λ-particle in a nucleus is esti- mated on the assumption of an exchange force between a Λ a nucleon with K-mesons as the intermediate particles. P.T.Matthe

530.1

4825. EXPLICIT NON-CENTRAL POTENTIALS AND WA FUNCTIONS FOR GIVEN S-MATRICES. T.Fulton and R.G.Newton.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 677-717 (April, 19

Wave-functions and potentials are obtained for non-cent forces coupling angular momenta l and l + 2, with the scatte ing matrix and bound state energies as a starting point. The method, an extension of the techniques developed by Bargma for central forces, is based on the solution of an integral equation developed and discussed by Gel'fand and Levitan, Jost, Kohn and Newton. The ensuing non-central potentials are the first spin-orbit and tensor potential combinations known for which the Schrödinger equation is solvable in clos form. The results allow the approximation of an experiment given S-matrix by one whose elements are rational functions of the wave-number k and subsequent determination of the wave-function and potential by purely finite algebraic means

530.145

4826. GENERAL PROPERTIES OF THE FIXED SOURCE MESON THEORY. M.Cini and S.Fubini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 764-71 (April, 1956).

Three relationships connecting the renormalized and unrenormalized coupling constants to the scattering amplitudes are deduced as rigorous consequences of the fixed source meson theory. The expressions for the scattering amplitudes deduced in the framework of the one-meson approximation and fitted to experiment in the low energy region do not satisfy these sum rules. It is shown that agreement between theory and experiment at low energy requires the high energy (above the cut-off) contributions to the sum rules to be dominant. A.

530.145

4827. THE THEOREM ON INCOMING WAVES. D.Park.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 979-87 (May, 1956).

The general form of the following theorem is stated and proved: If a particle is scattered by two potentials, then the resulting amplitude for a real transition may be written as the sum of two parts. The first is the amplitude for scattering by either of the potentials acting alone. The second is that for scattering by the other potential, where the incident wave is the wave-function belonging to the first potential in which the asymptotic form of the "scattered" wave moves inward. Some remarks are added concerning the applications of this theorem in quantum mechanics and the theory of fields. A.

530.145

4828. THE S-MATRIX FOR NEUTRAL PS–PV MESON–NUCLEON INTERACTION. J.S.R.Chisholm.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 338-44 (April, 1956).

Nucleon and neutral meson fields with an exponential interaction, derived from the PS–PV interaction by the Dyson transformation, are studied. A new system of graphs called "skeletons" is described; the S-matrix for any process is the sum of terms corresponding to skeletons with the appropriate external lines. A.

530.145

4829. INFLUENCE OF "NEW UNSTABLE PARTICLES" ON THE ELECTROMAGNETIC PROPERTIES OF NUCLEONS. G.Sandri.
Phys. Rev., Vol. 101, No. 5, 1616-17 (March 1, 1956).

In order to explain the weak electron neutron interaction it is suggested that hyperon and K-meson fields associated with nucleons suppress the charge cloud in a neutron arising from virtual-meson formation. It is pointed out that conservation of "strangeness" — with Gell-Mann's assignment of isotopic spin — allows $n \rightarrow \Sigma^- + K^+$ which would tend to cancel the meson charge cloud arising from $n \rightarrow p + \pi^-$ but forbids $n \rightarrow \Sigma^+ + K^-$. Scalar K-mesons with scalar interaction would not affect the anomalous magnetic moment (which can account for the observed electron neutron interaction) while giving effective charge suppression. H.Motz

530.145

4830. POSSIBLE ORIGIN OF L.S FORCES IN NUCLEI. D.H.Frisch.
Phys. Rev., Vol. 101, No. 6, 1833-4 (March 15, 1956).

A very rough estimate of the l.s force arising from the meson cloud in a nucleus. P.T.Matthews

530.145

4831. PROTON CHARGE DENSITY. F.Zachariasen.
Phys. Rev., Vol. 102, No. 1, 295-6 (April 1, 1956).

Using the one-meson approximation in the Chew–Low theory, the charge distribution in the meson cloud of a proton is expressed in terms of renormalized perturbation theory and the meson–nucleon scattering phase-shifts. P.T.Matthews

530.145

4832. DERIVATION OF LOW SCATTERING FORMALISM. A.Klein.
Phys. Rev., Vol. 102, No. 3, 913-16 (May 1, 1956).

The Yang–Feldman formalism is applied to the derivation of the transition amplitude for boson–fermion scattering in a form which makes evident its connection with a method of derivation suggested by Wick. A.

530.145

4833. MULTIPLE PRODUCTION OF PARTICLES IN THE COLLISIONS OF HIGH ENERGY NUCLEONS WITH NUCLEI. S.Z.Belen'kiĭ and G.A.Milekhin.
Zh. éksper. teor. Fiz., Vol. 29, No. 1(7), 20-32 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 14-22 (Jan., 1956).

The collisions of high-energy nucleons with nuclei are examined in a statistical theory of the multiple production of particles. The relation is calculated between the entropy of the nucleon–nucleus system (as determined by the initial stage of the collision), and the number of particles resulting when the system flies apart into individual particles. The entropy of the system is calculated using relativistic hydrodynamics. The dependence of the number of produced particles on the energy of the incident nucleon and on the atomic weight of the nucleus is found. A.

530.145

4834. THE STATISTICS OF CHARGE-CONSERVING SYSTEMS AND ITS APPLICATION TO THE THEORY OF MULTIPLE PRODUCTION. V.B.Magalinskiĭ and Ya.P.Terletskiĭ.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 151-7 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 143-7 (Jan., 1956).

The quantum statistics of systems with a variable number of non-interacting particles is generalized to the case of an aggregate of oppositely charged particles, which obey the law of charge conservation. Formulae which differ from the corresponding formulae of ordinary quantum statistics are derived for the total number of particles and the total energy. The results obtained are applied to the theory of multiple production of mesons. The following questions are studied: the dependence of the energy on the relative proportions of neutral and charged mesons, the formation of nucleon–antinucleon pairs, and the relation between the yield and the primary energy. The theory is compared with the available experimental data. A.

530.145

4835. STRONG COUPLING NUCLEOMESODYNAMICS. I. APPROXIMATE METHOD. SPIN-CHARGE MOTION. S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 304-16 (1956). In Russian.

An approximate method and mathematical formalism are presented which permit one to determine explicitly the wave function and eigenvalues of the energy of a system consisting of an infinitely heavy nucleon strongly interacting with a meson field. The mesons are assumed to be pseudoscalar, the interaction of the symmetric pseudovector (gradient) type and finally the nucleon is assumed to be extended. By means of an approximate method the Hamiltonian of the system has been simplified and the spin-charge part of the wave function of the system and corresponding energy have been separated and determined. A.

530.145

4836. STRONG COUPLING NUCLEOMESODYNAMICS. II. THE GROUND AND ISOBAR STATES. NUCLEON CHARGE AND SPIN. V.N.Baĭer and S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 317-29 (1956). In Russian.

A nucleon strongly interacting with a pseudoscalar meson field is considered. The interaction is considered to be of the pseudovector type. Eigenvalues of the nucleon energy, charge and spin, and also the explicit form of the wave function of the

system are determined. The ground and isobar states of the system have been obtained. A.

530.145

4837. MESON FIELD THEORY. III. CONSERVATION OF PHYSICAL QUANTITIES. A.A.Borgardt.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 330-3 (1956). In Russian.

For Pt II see Abstr. 9919 (1954). The present paper is concerned with the investigation of the density of physical quantities and the conservation laws for meson fields with anti-commuting matrices whose properties have been described in the earlier papers. A.

530.145

4838. ON THE DETERMINATION OF THE WAVE FUNCTIONS OF THE PARTICLE WITH SPIN ħ INTERACTING WITH A MAGNETIC FIELD OF CONSTANT INTENSITY. G.Petiau.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 997-1000 (Feb. 20, 1956). In French.

Wave equations desci ibing the vector meson in a constant magnetic field are reduced to a system soluble in terms of Weber–Hermite functions. N.M.King

530.145

4839. ON THE DETERMINATION OF THE WAVE FUNCTIONS OF THE PARTICLE WITH SPIN h INTERACTING WITH AN ELECTRIC FIELD OF CONSTANT INTENSITY. G.Petiau.
C.R. Acad. Sci.(Paris), Vol. 242, No. 9, 1134-7 (Feb. 27, 1956). In French.

By the methods of the preceding abstract, the wave functions are explicitly determined as linear combinations of Weber–Hermite functions. N.M.King

530.145

4840. FREE PARTICLE WITH SPIN: SUPPLEMENT TO OUR RELATIVISTIC COVARIANT THEORY OF THE HERMITIAN SCALAR PRODUCT. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1581-3 (March 19, 1956). In French.

Projective operators of the form $P(\gamma, k) = (k_0 - i\gamma_\lambda k^\lambda)/2k_0$ and $P(\beta, k) = -(\beta_\lambda\beta_\mu k^\lambda k^\mu + ik_0\beta_\lambda k^\lambda)/2k_0^2$, where $k^\lambda$ is the frequency 4-vector, are used to exhibit previous results, (Abstr. 932/1956), in a more compact form. R.A.Newing

530.145

4841. RELATIVISTIC INVARIANCE IN QUANTUM MECHANICS. E.P.Wigner.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 517-32 (March, 1956).

A detailed analysis is made of the theoretical possibilities of constructing a quantum mechanics and consequently of a description of the elementary particles, based on a definition of the postulates of relativistic invariance and then on the symmetry properties connected with the complete Lorentz group, including displacements in space and time and inversions of both the space and the time coordinates. It is then pointed out how the validity of every conclusion deriving from symmetry considerations depends essentially from the fundamental problem of the 'measurability' of the field quantities. A.

530.145

4842. ON A CONFORM-INVARIANT SPINOR WAVE EQUATION. F.Gürsey.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 988-1006 (May, 1956).

As a possible basis for a unitary description of particles a new spinor wave equation is proposed which is similar to Heisenberg's non-linear generalization of Dirac's equation but exhibits in addition an invariance with respect to conformal transformations. A 2 x 2 matrix formalism is developed in view of obtaining a synthetic expression for conformal transformations as well as for spinor equations of Dirac's type. A direct proof of the conform-invariance of the new equation is then given with the aid of this formalism and an explicit transformation law for the wave-function is derived. It is furthe shown that the unquantized equation allows for the propagat of plane waves corresponding to particles of different rest masses.

530.145 : 53

4843. ENTROPY IN QUANTUM MECHANICS. U.Farine and A.Gamba.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1033-44 (May, 195

A critical discussion from a physical standpoint of the proofs given so far of the second principle of thermodynam in quantum mechanics shows how information theory allows much more satisfactory physical interpretation.

530.

4844. WAVE FUNCTIONS OF A HARMONIC OSCILLATO J.Plebanski.
Phys. Rev., Vol. 101, No. 6, 1825-6 (March 15, 1956).

By means of some special unitary operators, theo rems are obtained extending classical properties of Kennar packets (classical motion of the centre, and periodic time-dependence of $\Delta x$) over all solutions of the oscillator wave equation. These results are also generalized for the quantu field theory. Using a special "functional representation", nonspreading wave packets with classical properties are gi for a general free field.

530.

4845. SPURIOUS SOLUTIONS OF THE BETHE–SALPET EQUATION. D.A.Geffen and F.L.Scarf.
Phys. Rev., Vol. 101, No. 6, 1829-30 (March 15, 1956).

Corrections to previous work (Abstr. 907/1956) giving results in agreement with Wick (Abstr. 750/1955).
P.T.Matth

530.

4846. SPECTRUM OF THE BETHE–SALPETER EQUAT R.E.Cutkosky and G.C.Wick.
Phys. Rev., Vol. 101, No. 6, 1830-1 (March 15, 1956).

It is shown that all eigenvalues do not tend to zero in t limit of zero binding energy. P.T.Matth

530.

4847. ENERGY CORRECTIONS AND PERSISTENT PERTURBATION EFFECTS IN CONTINUOUS SPECTRA. II. TI PERTURBED STATIONARY STATES. L.van Hove.
Physica, Vol. 22, No. 4, 343-54 (April, 1956).

Continues the systematic investigation undertaken in PI (Abstr. 2689/1956) of a class of perturbations of continuou energy spectra producing, in addition to scattering and re ion processes, self-energy and cloud effects which affect a all times the motion of wave packets and which are of the t occurring in the quantum theory of interacting fields. The main result presented here is the explicit determination of the perturbed stationary states. The formula obtained is u to express the motion of wave packets and to connect it wit its asymptotic properties for large times as established earlier. A special example is treated as illustration of the general method and a crude preliminary discussion is give the aspect under which the renormalization programme wil appear in the present formalism.

530.15 : 541.1

4848. ON THE DESCRIPTION OF RATE PROCESSES B MEANS OF RELAXATION TIMES. R.O.Davies and J.Lam
Proc. Phys. Soc. B, Vol. 69, Pt 3, 293-300 (March 1, 195

Attention is drawn to the importance of recognizing th various relaxation times associated with a single relaxatio mechanism. The physical origin of the differences betwee the relaxation times is indicated and the relationships betw them are illustrated by examples. A general formula is de rived which relates the relaxation times for a single mech under different thermodynamic constraints. Connection is

established between chemical rate constants and relaxation times. It is concluded that there is no intrinsic relaxation time derivable on a kinetic basis without reference to the thermodynamic conditions under which the relaxation takes place. A.

530.162

4849. DEFINITION AND METHOD OF CALCULATION OF THE STATISTICAL DISTRIBUTION FUNCTION [g(x)] ASSOCIATED WITH A PHYSICAL MAGNITUDE [X]. J.Peretti.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1416-17 (March 12, 1956). In French.

g(x) is defined as the function whose nth moment (in the sense of Stieltjes) is equal to the statistical mean value of $X^n$. g(x) can be calculated by the use of linear integral transforms. E.H.Sondheimer

530.162

4850. ENTROPY IN QUANTUM STATISTICS.
R.L.Stratonovich.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 547-58 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 426-34 (Nov., 1955).

Various statistical mechanical expressions for the entropy are considered, and their interrelations are discussed. P.T.Landsberg

530.162 : 512.851

4851. MATRIX ASPECTS OF BOSON THEORY.
A.A.Borgardt.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 334-41 (1956). In Russian.

Some relations are presented which permit one to go over from anticommutative matrices to Kemmer matrices at any stage of the computations. A study is made of the connection between $\Gamma_\mu$ and the matrices of irreducible representations of the Kemmer–Dirac algebra and also the Tamm matrices. A.

530.162

4852. GENERALIZED FORMULATION OF THE DIFFUSION EQUATION FOR A SINGLE PARTICLE. L.Yanoshi (Jánossy).
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 351-61 (1956). In Russian.

A general formulation of the diffusion equation for a single particle is given from which a number of familiar equations follow as particular cases. As an example of application of the equation the scattering of particles in a uniform absorber is considered. A.

530.162 : 537.591

4853. ON THE THEORY OF STOCHASTIC PROCESSES IN COSMIC RADIATION. L.Pal.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 362-6 (1956). In Russian.

An investigation has been carried out on the kinetic equation of Janossy generalized for the case when the random quantity $\xi(t)$ does not remain constant between its two neighbouring discontinuities but follows some causal law. The equation thus derived can be fruitfully used to study various stochastic processes in the cosmic radiation. A.

530.162 : 539.172

4854. APPLICATION OF THE THEORY OF STOCHASTIC PROCESSES TO INVESTIGATION OF NUCLEAR FISSION. L.Pal.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 367-73 (1956). In Russian.

The statistical theory of the ionization chamber is discussed with reference to nuclear fission. The average number of pulses due to the $\alpha$-particle background is determined. The theory of random processes is developed in connection with this stochastic process. A.

## GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.258 : 535.55

4855. A PHOTOELASTIC METHOD OF TWO-DIMENSIONAL SEPARATION OF STRESSES ALONG A LINE OF SYMMETRY BY USING THE ISOCHROMATIC FRINGES ONLY. S.P.Christodoulides.
Brit. J. appl. Phys., Vol. 7, No. 5, 190-4 (May, 1956).

Examination of the general equations of equilibrium in curvilinear co-ordinates for a two-dimensional model shows that when these are applied to points on an axis of symmetry, the isochromatics and their orthogonals being taken as axes of co-ordinates, an equation of the same form as the Lamé–Maxwell equations is obtained, and this leads to a method of separating the stresses on an axis of symmetry by the use of the isochromatic fringes only. A.

531.55

4856. MISSILE GUIDANCE BY THREE-DIMENSIONAL PROPORTIONAL NAVIGATION. F.P.Adler.
J. appl. Phys., Vol. 27, No. 5, 500-8 (May, 1956).

Following a brief comparison of three collision-seeking types of navigation — pure pursuit, constant-bearing collision, and proportional navigation — the usual definition of planar proportional navigation is extended to three dimensions. Based upon a simple criterion for optimum navigation to the line-of-sight motion, a proper formulation is found in terms of the geodesic and normal curvatures of the missile path on the surface generated by the line of sight. By a suitable choice of a reference coordinate system, the missile-target kinematic relationships are then linearized, assuming relatively small deviations of the missile from a collision course. Upon combining these "geometry feedback" equations with the equations of guidance, the missile trajectory is found to be given in terms of two independent linear differential equations of identical form and of one higher order than the missile transfer function. Typical solutions are found for some simple cases. The character of the trajectory is shown to depend on an "effective navigation constant" proportional to the missile navigation constant (or gain) and the ratio of missile speed to closing speed; a value of this parameter greater than two is found to be necessary to insure finite terminal missile acceleration. Two example trajectories are calculated from both the exact and the linearized trajectory equations to indicate the accuracy of the linearization. A.

## MECHANICAL MEASUREMENTS 531.7

531.714 : 531.784 : 533.5

4857. ELECTRONIC INDICATORS OF MECHANICAL QUANTITIES. L.A.Goncharskiĭ.
Uspekhi fiz. Nauk, Vol. 55, No. 1, 81-100 (1955). In Russian.

A survey, including material on the electronic micrometer, vibrometer, dynamometers, manometers. 17 refs. C.R.S.Manders

531.715 : 535.417

MEASUREMENT OF LENGTH BY INTERFERENCE. See Abstr. 4342

531.715 : 535.417

INTERFERENCE COMPARATOR OF THE TEST LABORATORY OF THE CONSERVATOIRE NATIONAL DES ARTS ET MÉTIERS. See Abstr. 4343

531.72 : 535.41

4858. TWO-DIMENSIONAL STRAIN MEASUREMENT BY MOIRÉ. R.H.Bromley.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 373-81 (March 1, 1956).

Applications of moiré to surface strain measurement are described. A theory of moiré is developed, based on the concept of the covariant vector, which leads to a simple description of infinitesimal strain fields. Extension to the case of finite strain is considered, and parallels with crystallography are drawn. A.

531.787.9

4859. CONVECTION TYPE MANOMETER. J.B.Johnson.
Rev. sci. Instrum., Vol. 27, No. 5, 303-5 (May, 1956).

A manometer is described which depends on heat convection rather than molecular heat conduction. Its range may be from a few mm of Hg to atmospheric pressure or more. Its performance for various conditions is explored, including its possible use as an inclinometer. A.

531.787.5 : 535.417

INTERFEROMETRIC MEASUREMENTS OF THE SMALL DEFORMATIONS OF A MEMBRANE APPLIED TO THE MEASUREMENT OF HIGH PRESSURES. See Abstr. 4344

## MECHANICS OF FLUIDS 532

532.11 : 532.623

4860. AN EXPERIMENTAL STUDY OF THE COLLAPSE OF A SPHERICAL CAVITY IN WATER. R.H.Mellen.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 447-54 (May, 1956).

The pressure wave produced by the collapse of an electrically generated spherical cavity (~ 1 cm in radius) in water was measured by means of a small electroacoustic hydrophone ($\frac{1}{16}$ in. in diameter) at a distance of 50 cm. The pressure was found to increase as the bubble collapsed according to the $t^{-4/3}$ (time) law in the interval corresponding to subsonic flow. The pressure then suddenly jumped to a higher value and rapidly decayed to zero. This rapid increase in pressure is assumed to be a shock wave. Using Gilmore's theory for the collapse of the cavity and finite amplitude-wave theory for the pressure wave, we find that the value of the pressure-amplitude characteristic at the shock front corresponds to a cavity-wall velocity approximately equal to the velocity of sound. Since the shock wave has been attenuated, the peak wall velocity must be greater than this value. A.

532.133 : 541.182

4861. VISCOMETRIC ANALYSIS OF DISPERSIONS AT SMALL SHEAR STRESSES. R.R.Myers, J.C.Miller and A.C.Zettlemoyer.
J. appl. Phys., Vol. 27, No. 5, 468-72 (May, 1956).

The flow behaviour of certain dispersions at small shear stresses has been studied in a rotational viscometer. Criteria which were used in analysing the dispersions are the relative viscosity and its temperature dependence, the ratio of viscosities at infinite and zero shear, sedimentation rates, and the existence of a critical volume concentration for the occurrence of non-Newtonian behaviour. A.

532.137 : 536.48

NEW METHOD FOR MEASURING THE ABSOLUTE VISCOSITY OF LIQUID HELIUM II. See Abstr. 4368

532.517

4862. THE FORCES ACTING ON TWO EQUAL CIRCULAR CYLINDERS PLACED IN A UNIFORM STREAM AT LOW VALUES OF REYNOLDS NUMBER. H.Fujikawa.
J. Phys. Soc. Japan, Vol. 11, No. 5, 558-69 (May, 1956).

The steady slow motion of a viscous fluid past two parallel circular cylinders of equal radius, with their axes in one plane perpendicular to a uniform flow, is discussed on the basis of Oseen's linearized equations of motion. Expansion formulae in powers of the Reynolds number R for the forces acting on one of the cylinders are obtained correct to the order of R, the lowest order terms being $O(R^{-1})$. After detailed numerical calculations, it is shown that the drag on on cylinder decreases as the distance between the two cylinders decreases and also that each cylinder experiences a repulsiv force. A

532.517

4863. THEORY OF TURBULENCE. S.Chandrasekhar.
Phys. Rev., Vol. 102, No. 4, 941-52 (May 15, 1956).

It is pointed out if there are aspects of the turbulence phenomenon which are truly universal, then they should be capable of being characterized in terms of the two paramete $\epsilon$ and $\nu$ which denote the constant rate of dissipation of ener per unit mass and the kinemetic viscosity respectively and these two parameters only without reference either to the mean square velocity $\langle u_1^2 \rangle_{Av}$ or to the size of the largest energy containing eddies. This is a slight modification of Ko mogoroff's similarity principles as currently formulated. It appears that

$$\chi = \partial\Psi(r,t)\partial r, \quad \text{where } \Psi(r,t) = \tfrac{1}{2}\langle (u_1' - u_1'')^2 \rangle_{Av},$$

and $u_1'$ and $u_1''$ are the velocities in the x-direction (say) at two points on the x-axis separated by a distance r and at times an interval t apart, can be so specified. The similar principles require that if this is the case, $\chi$ should be of the form

$$\chi \equiv (\epsilon^3/\nu)^{1/4} X(r(\epsilon/\nu^3)^{1/4},\ t(\epsilon/\nu)^{1/2}),$$

where X is a universal function of the arguments specified. In the limit of zero viscosity, $\chi$ must have the more special form

$$\chi \to r^{-1/3}\sigma(t/r^{2/3}) \quad (\nu \to 0).$$

The boundary conditions on $\sigma(x)$ are that $\sigma = q_0 (> 0)$ and $d\sigma/dx = 0$ at $x = 0$ and $\sigma \to 0$ as $x \to \infty$. It is shown that with a slig modification of the premises of the theory described previously, an equation for $\chi$ can be derived which is compatible with the requirements of the similarity principles as formulated. In particular the ordinary differential equation for $\sigma$ t which the theory leads can be solved. The solution for $\sigma$ which is found satisfies all the boundary conditions of the pr lem and is unique, apart from adjustable scale factors. The predicted evolutions of $\chi$ and the vorticity correlations are illustrated.

532.5

4864. VELOCITY DISCONTINUITY INSTABILITY OF A LIQUID JET. B.Dunne and B.Cassen.
J. appl. Phys., Vol. 27, No. 6, 577-82 (June, 1956).

The instability of a high-speed liquid jet with a velocity which has a transient rise followed by a linear decay with tir is studied experimentally and theoretically. The jet is produced experimentally by subjecting a liquid reservoir to a shock-wave pressure. Using a shadowgraph technique, in an interval of 30 $\mu$sec four successive $\frac{1}{4}$ $\mu$sec exposures were taken using jets of water and ethanol in external atmosphere of air and helium. It is found theoretically that a velocity di continuity is advanced through the jet at a velocity which is the mean of the instantaneous particle velocities immediatel in front of and behind the discontinuity. The discontinuity co sists of a thin disk of liquid normal to the jet axis. Nodules previously observed on high-speed liquid jets can be explain by this mechanism.

532.593 : 550.34

4865. SURFACE WAVES IN THE OCEAN EXCITED BY UNDERWATER EARTHQUAKES. Yu.L.Gazaryan.
Akust. Zh., Vol. 1, No. 3, 203-17 (1955). In Russian.

Assuming an upheaval of a section of the ocean bed of piston type, an integral representation is found for the poten tial of the gravitational wave to which it would give rise. The paper also makes an investigation into the wave conditio

at great distances for such type of sudden upheaval.
C.R.S.Manders

## CAPILLARITY 532.6

532.61.08

4866. DEVELOPMENT OF THE BUBBLE-PRESSURE METHOD FOR DETERMINATION OF THE SURFACE TENSION OF LIQUIDS. K.H.Cuny and K.L.Wolf.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 57-77 (1956). In German.

Using Schrödinger's approximation and Sugden's solution of the Gauss–Laplace differential equation an expression is derived for surface tension using the two-tube method (radii $r_1$, and $r_2$; $r_1 \ll r_2$, the tips being $\Delta t$ apart vertically). The whole subject has been very well treated and it is claimed that very high accuracy can be achieved using the method.
T.C.Toye

532.65

4867. SHATTERING OF LARGE DROPS. R.H.Magarvey and B.W.Taylor.
Nature (London), Vol. 177, 745-6 (April 21, 1956).

When falling through the air drops larger than 12 mm are shown by high-speed photographic techniques to flatten, and the centre of the flattened drops then to bulge upwards and open (in the manner of a parachute) before finally rupturing into a shower of smaller droplets. W.Good

## MOLECULAR THEORY OF LIQUIDS 532.7

532.7

4868. POTENTIAL ENERGY OF A MOLECULE IN A LIQUID. G.H.Vineyard.
J. chem. Phys., Vol. 24, No. 3, 617 (March, 1956).

The potential energy function proposed by Girifalco (Abstr. 115/1956) is not considered suitable since (it is claimed) it merely defines a barrier at $R_0$ (the distance of closest approach of two molecules). It is thought that the potential well provided is not adequate unless one introduces an arbitrary cut-off for the integral which defines the partition function used by Girifalco. The physical validity of this step is questionable. T.C.Toye

532.7

4869. POTENTIAL ENERGY OF A MOLECULE IN A LIQUID: CALCULATIONS FOR ARGON. L.A.Girifalco.
J. chem. Phys., Vol. 24, No. 3, 617-18 (March, 1956).

The author uses his potential energy function (Abstr. 115/1956) for an atom in liquid argon and a diagram showing a very satisfactory potential well is given. T.C.Toye

532.7 : 532.13

4870. VISCOUS FLOW AND THE CONSTITUTION OF LIQUID BORON TRIOXIDE. J.D.MacKenzie.
J. chem. Phys., Vol. 24, No. 4, 925-6 (April, 1956).

By assuming that the principal units of flow are $B_2O_3$, excellent agreement is obtained between the free energy of activation ($\Delta F^*$) for flow evaluated from recent viscosity data, and that evaluated from the relationship $\Delta E_V/\Delta F^* = 2.45$, where $\Delta E_V = \Delta H_V$, (the latent heat of vaporization), $-RT$. A discussion on the compatibility with experiment of other views on the constitution of liquid $B_2O_3$ is given. W.Good

532.7

4871. ELECTRON-DIFFRACTION STUDY OF THE STRUCTURE OF SUPERCOOLED LIQUID BISMUTH. M.Takagi.
J. Phys. Soc. Japan, Vol. 11, No. 4, 396-405 (April, 1956).

Thin bismuth films were prepared on crystal surfaces by evaporation and the liquid state of the films at temperatures above and below the ordinary melting point (271° C) has been studied by means of the reflection method of electron diffraction. The marked supercooling of the films (M.Takagi/1954) has been utilized for the study below the melting point. A method of eliminating difficulties inherent in intensity measurement by the reflection method and a method of refining the observed intensity values were developed. The radial distribution curves at 400° C, 271° C (the melting point), 175° C, 130° C and 110° C (a little above the solidification temperature) were computed from experimental data. The curves showed a systematic change with temperature. It was revealed that the atomic arrangement at 110° C resembles closely that of solid bismuth. Above the melting point a tendency towards close-packed structure was noted. A.

532.7 : 537.226.2 : 539.13

4872. MICROWAVE ABSORPTION AND MOLECULAR STRUCTURE IN LIQUIDS. XII. CRITICAL WAVELENGTHS AND INTERMOLECULAR FORCES IN THE TETRAHALOGENATED METHANES. R.C.Miller and C.P.Smyth.
J. chem. Phys., Vol. 24, No. 4, 814-17 (April, 1956).

The dielectric constants and losses of bromotrichloromethane, dibromodichloromethane, tribromochloromethane, dibromodifluoromethane, tribromofluoromethane, and trichlorofluoromethane, and of two solutions of trichlorofluoromethane in carbon tetrachloride have been measured at wavelengths of 1.24, 3.22, and 10.0 cm at temperatures between 0 and 60°. The arc plots constructed from these data and the measured static dielectric constants have been used to obtain the optical dielectric constants and the critical wavelengths at which the loss is a maximum. The optical and the static dielectric constants have been used to calculate, by means of the Onsager equation, the values of the small molecular dipole moments, which are in excellent agreement with such values as have been previously determined from vapour measurements. For five of the six molecules studied, the critical wavelengths, which are proportional to the molecular relaxation times for these liquids of low dielectric constants, are roughly consistent with the intermolecular attractive forces as evidenced by the boiling points, polarizabilities, and viscosities of the liquids. The departure of the tribromofluoromethane molecule from spherical form is sufficiently great to account for its larger critical wavelength. The internal or microscopic viscosities hindering molecular rotation in the liquids are much smaller than the measured macroscopic viscosities. A.

532.72

4873. STUDY OF SORET EFFECT IN IONIC SOLUTIONS. I. OPTICAL METHOD AND RESULTS FOR POTASSIUM CHLORIDE. J.Chanu and J.Lenoble.
J. Chim. phys., Vol. 53, No. 4, 309-15 (April, 1956). In French.

An interferometric method has been worked out and applied to the study of thermodiffusion in electrolyte solutions. Measurements on potassium chloride at eight concentrations between 1 and 3.5 N, have confirmed the general theory of the Soret effect and the values of the coefficients of thermodiffusion calculated from them agree reasonably with those of Tanner, although Tanner's results vary with concentration less than those obtained in this research. R.C.Murray

532.72

4874. THERMODIFFUSION IN CONDENSED PHASE SYSTEMS. NEW APPARATUS FOR MEASUREMENT OF SORET COEFFICIENTS. G.Thomaes.
J. Chim. phys., Vol. 53, No. 4, 407-11 (April, 1956). In French.

The liquid to be studied is allowed to flow through a clearance of 0.01 cm between two nickel-plated brass plates kept at different temperatures; the emergent liquid is divided into hot and cold streams and these are collected separately and analysed. Coefficients as low as $10^{-8}$ cm$^2$.sec$^{-1}$ can be

measured this way. A theoretical discussion shows that under certain experimental conditions the results should be identical with those obtained with a standard type of apparatus, in which concentration changes are measured optically.

R.C.Murray

532.77 : 532.13 : 541.64

4875. ON THE QUESTION OF "LIMITING VISCOSITY" IN SOLUTIONS WHICH CONTAIN DIFFERENT KINDS OF MOLECULES. G.Langhammer and M.Richter.

Naturwissenschaften, Vol. 43, No. 6, 125-6 (1956). In German.

On the assumption that at low concentrations the specific viscosities are additive, it is shown that the "limiting viscosity" of a mixture of two polymers varies linearly with the mixture ratio. This conclusion is not fulfilled in a mixture of polyvinylpyrrolidone and polyvinyl alcohol (mol. wts. about 28 000) in water.

W.Good

## MECHANICS OF GASES 533

533.5

4876. OBSERVATIONS ON THE CHARACTERISTICS OF THE COLD CATHODE IONIZATION GAUGE. J.H.Leck and A.Riddoch.

Brit. J. appl. Phys., Vol. 7, No. 4, 153-5 (April, 1956).

A Penning gauge has been calibrated against a Bayard–Alpert gauge down to $10^{-8}$ mm Hg. The sensitivity decreased markedly during 200 hrs operation. This is thought to be due to carbon formation on the cathode surfaces inhibiting secondary emission.

A.H.W.Beck

533.5

4877. THEORY OF MOLECULAR PUMPS AT VERY LOW PRESSURES. C.Mercier.

J. Phys. Radium, Vol. 17, No. 3, 1 A - 11 A (March Suppl., 1956). In French.

A general treatment of the distribution of pressure in a molecular pump consisting of a rotor and stator, separated by a narrow gap. Account is taken of the effect of removal of adsorbed gases from the rotating surfaces. For the case of a concentric stator and rotor, comparison with experiment reveals good agreement.

D.G.Avery

533.5

4878. DIFFUSION PUMPS WITH MERCURY AND OIL AS OPERATING SUBSTANCES. G.C.Mönch.

Naturwissenschaften, Vol. 43, No. 5, 103 (1956). In German.

Announces briefly that it has been found possible to use a filling of mercury and oil in a many-stage glass diffusion pump, the mercury vapour acting at the first and the oil vapour at later jets.

S.Weintroub

533.59

4879. MAGNETICALLY OPERATED VACUUM VALVE. P.Fisher.

Rev. sci. Instrum., Vol. 27, No. 5, 271-2 (May, 1956).

A valve is described which isolates a vacuum system from its mechanical pump should a power failure occur. Also, during the isolation process, air is let into the backing pump. The valve is characterized by low cost, low power consumption, simplicity, and reliability of operation.

A.

533.6.01 : 538.12

4880. THE SOLUTION OF INHOMOGENEOUS ONE-DIMENSIONAL MOTION PROBLEMS IN MAGNETIC GAS DYNAMICS. S.A.Kaplan and K.P.Stanyukovich.

Zh. éksper. teor. Fiz., Vol. 30, No. 2, 382-5 (1956). In Russian.

Particular solutions describing the movement of gases in a magnetic field for the case of variable entropy are presente The motion of the gas is also investigated for the case when the proportionality coefficient between the field strength and gas density depends on the entropy.

533.6.0

4881. ON THE STEADY FLOW PAST A SPHERE AT HIG REYNOLDS NUMBER USING OSEEN'S APPROXIMATION. K.Stewartson.

Phil. Mag. (Ser.8), Vol. 1, No. 4, 345-54 (April, 1956).

The flow of a viscous fluid past a sphere at high Reynol number as given by Oseen's approximation, in which the inert terms of the equations of motion are linearized, is discusse It is found that a boundary layer is formed on the forward s and a wake extending to infinity on the rearward side. Insid the wake, which is bounded by a circular cylinder with its generators parallel to the undisturbed direction of the strea lines, the fluid at infinity is moving towards the sphere, wh outside it is moving away with the undisturbed velocity, and there is a shear layer at the cylinder.

533.6.011.3 : 533

4882. ON DRAG OF SOME BODIES IN FREE MOLECULE FLOW. M.Z.v.Krzywoblocki and G.Shinosaki.

Acta phys. Austriaca, Vol. 10, No. 1-2, 34-53 (1956).

The authors extend some results of Heineman for the dr on a convex body of some particular shape in the regime of free molecule flow, assuming various laws of reflection. In particular, special attention is paid to the collisions of the molecules reflected from the surface, an item which present great difficulties of both physical and mathematical nature.

533.6.011

4383. PRESSURE DISTRIBUTION ON A WALL UNDER IMPACT OF A SUBSONIC GAS JET. H.Roth.

Acta. phys. Austriaca, Vol. 10, No. 1-2, 142-8 (1956).

The solution of the problem of the head-on impact of an incompressible jet upon an infinite wall has been generalized to give the flow for a jet of compressible fluid. As an examp for the use of the method computations have been carried ou to find the pressure distribution on the wall for a jet with Ma number M = 0.826 at infinity upstream. A comparison has been made of the pressure at the wall for compressible and compressible flow.

533.6.01

4884. THE APPLICATION OF BRIGHT LIGHT-SOURCES TO THE STUDY OF THE EVOLUTION OF AERODYNAMIC FIELDS. G.Batailler.

J. Phys. Radium, Vol. 16, No. 12, 115 S-117 S (Dec., 1955). In French.

Pre-requisities, relating to the application of the gener technique of chromophotography to the study of aerodynamic fields of flow, and referring to the choice of fine solid partic in the field and periodic interruption of the light source, are referred to (see Bourot, Thesis, Paris, 1949), and illustrations are given relating to the production and detachment of symmetrical vortices, the birth of alternate vortices, and th production of an eddying wave. A xenon discharge lamp, sui ably interrupted, is used as the light source.

J.S.G.Thom

533.6.01

4885. A STUDY OF THE COMPRESSIBLE FLOW PAST TOMOTIKA–TAMADA'S PROFILES. H.Takami.

J. Phys. Soc. Japan, Vol. 11, No. 4, 446-51 (April, 1956).

A number of approximate methods are applied to study the two-dimensional high subsonic flow of an adiabatic gas past a family of profiles given by Tomotika and Tamada. Th velocity distributions over the profiles are calculated by me of Kármán–Tsien's, the WKB, the $M^2$-expansion and Mekey Imai's methods, and are compared with Tomotika–Tamada' exact solutions as well as with Naruse's results by the thin-

ing-expansion method. The convergency and validity of the bove-mentioned methods are discussed. It is noticed that ıere exists certain amount of discrepancy between Tomotika–'amada's results and those of the present calculation; this ıight be considered as being due to the difference between the haracteristic of the hypothetical gas assumed in Tomotika–'amada's study and that of the adiabatic gas. A.

533.6.011.311

886. PRESSURE FLUCTUATIONS IN TURBULENT FLOW VER A FLAT PLATE. R.H.Kraichnan.
Acoust. Soc. Amer., Vol. 28, No. 3, 378-90 (May, 1956).

The pressure fluctuations exerted on a flat plate by a tur-ılent boundary layer flow are investigated. The approximate ependence of the mean-square-intensity, spatial scale, and equency scale on Mach number and distance from transition oint are estimated through the use of similarity arguments. he wave number spectrum of the pressure fluctuation dis-ibution over the surface of the plate is expressed in terms of ansforms of two-point velocity correlations and expressions :e derived for the driving force exerted on a rectangular ston set in the surface of the plate. It is found that the inte-:al over the boundary surface of the two-point quadratic orrelation function of the pressure fluctuation should vanish, ith the result that the mean-square force per unit area exerted ı a large area of the surface should tend to zero as the area ıcreases indefinitely. An idealized model of turbulent bound-ry layer flow is constructed and used to relate the spectrum ıd correlation function of the surface pressure distribution to ıe corresponding functions for a homogeneous turbulent flow. pplication of the theory to Laufer's data on turbulent channel ów indicates that the dominant contribution to the pressure uctuations should depend only on the mean velocity profile and ıe two-point quadratic correlation of the fluctuating velocity omponent perpendicular to the boundary surface. On the basis f the seriously incomplete data available the r.m.s. pressure uctuation from this source is tentatively estimated. The treat-ıent of the present paper is based on the assumptions of l) adiabatic conditions, (2) small compressibility, and (3) slow ate of growth of the boundary layer. A.

533.6.011.4

887. EXPERIMENTAL STUDIES OF SUPERSONIC FLOW PAST A CIRCULAR CYLINDER. C.-S.Kim.
J. Phys. Soc. Japan, Vol. 11, No. 4, 439-45 (April, 1956).

Experimental studies using shock tubes are presented, of ne mixed-type flow around a circular cylinder placed normal o the general flow of Mach number 1.35, 1.8, 2.7, 3.5, 4.0, ınd 6.0. With the Mach–Zehnder interferometer and schlieren nethod the following were measured: (a) shape of detached ıhock wave, (b) distance d of shock wave from the cylinder ıose, (c) pressure coefficient $C_p$ on the surface of the cylinder, d) density distribution behind the detached shock, (e) stream-ines in subsonic region. A.

533.6.011.4

888. REFLECTION OF SHOCK WAVES. I. PSEUDO-STATIONARY CASE. R.Kawamura and H.Saito.
J. Phys. Soc. Japan, Vol. 11, No. 5, 584-92 (May, 1956).

Results of theoretical and experimental investigations on ıhock reflection at a fixed wall are reported. In the region of regular reflection, agreement of theory and experiment is ound to be good except for the fact that experimental points extend slightly beyond the theoretical limit. A theoretical nvestigation of the flow characteristics is made on Mach re-lection cases with the conclusion that a singularity would ıppear at the triple point, and hence the reflected shock angle would not coincide with the theoretical one when the flow is subsonic behind the reflected shock. This theoretical predic-ion is fully confirmed by the results of shock angle measure-ment in schlieren pictures obtained by the experiment. In case of a strong incident shock, angle of the reflected shock de-creases discontinuously at the transition from regular to Mach reflection as expected from the theory. In case of a weak inci-dent shock, on the other hand, its change is continuous against the ordinary three-shock theory. It is found in the experiment that the boundary between these two cases takes place approxi-mately at $\xi = 0.42$, where $\xi$ is the pressure ratio across the incident shock. This is in good agreement with the theoretically predicted value, $\xi = 0.433$, above which the Mach reflection with a singularity at the triple point would appear. It corre-sponds to the condition of the stationary Mach reflection. Com-parisons of theory and experiment are also made in this paper on the condition at which the flow behind the incident shock is just sonic relative to the triple point and on the angle of the Mach stem. A shock tube was used throughout. A.

533.6.011.5

4889. A DIVERGENT SHOCK TUBE FOR OBTAINING SUPERSONIC FLOWS. F.Tamaki.
J. Phys. Soc. Japan, Vol. 11, No. 4, 434-9 (April, 1956).

A shock tube having a divergent low-pressure chamber just downstream of a partition diaphragm is presented as a simple method for obtaining supersonic flows of fairly high Mach numbers. Flow character in the divergent channel is examined both theoretically and experimentally. Interfero-metric studies of the flow past a double-wedge profile are presented for Mach numbers of 4.0 and 6.0. At M = 6.0, pressure distribution on the wedge surface deviates consider-ably from theory due to the thickening of the boundary layers. A.

533.6.011.5

4890. APPLICATION OF IMAI'S TRANSONIC APPROXIMA-TION METHOD TO THE COMPRESSIBLE FLOW PAST A KAPLAN BUMP. Y.Matunobu.
J. Phys. Soc. Japan, Vol. 11, No. 4, 452-7 (April, 1956).

Imai's transonic thin-wing-expansion method is applied to the compressible flow past a Kaplan bump. Calculation is carried out as far as the fourth approximation. The results are compared with those obtained by means of the usual thin-wing-expansion method which is based on the exact equation of motion, and then with those deduced from von Kármán's similarity hypothesis for the transonic flow, showing that Imai's method is more adequate than von Kármán's; the former presents satisfactory results over a wider range of the free-stream Mach number. A.

## MOLECULAR THEORY OF GASES 533.7

533.7

4891. EXPERIMENTAL DEVICE FOR A QUANTITATIVE DEMONSTRATION OF THERMAL DIFFUSION IN GASES. J.A.McMillan and C.E.Español.
Amer. J. Phys., Vol. 24, No. 4, 287-8 (April, 1956).

533.7

4892. KINETIC THEORY OF THE LORENTZIAN GAS; CASE OF 'MAXWELLIAN' MOLECULES. M.Bayet.
J. Phys. Radium, Vol. 17, No. 2, 167-8 (Feb., 1956). In French.

Reply to a criticism (Abstr. 982/1956) of the use of mean-free-path methods (Abstr. 7471/1954) in discussing the con-duction properties of a Lorentzian gas with fifth-power inter-actions. E.H.Sondheimer

533.7

4893. ON THE TWO SCHEMES OF APPROXIMATING THE TRANSPORT COEFFICIENTS (CHAPMAN–COWLING AND KIHARA). S.C.Saxena.
J. Phys. Soc. Japan, Vol. 11, No. 4, 367-9 (April, 1956).

The three elementary transport coefficients and the iso-topic thermal separation ratio have been evaluated over an ex-tensive range of temperatures by utilizing the expressions de-

rived on the approximation procedure due to Kihara, for the Lennard-Jones 12:6 model. These values have been compared with the corresponding and still higher order approximation values calculated on an alternative approximation scheme of Chapman and Cowling. The comparison of the results obtained on the two schemes of approximation indicates that the simple expressions of Kihara are more accurate and preferable even to the corresponding higher approximation expressions of Chapman and Cowling. A.

533.7 : 536.48

4894. SECOND VIRIAL COEFFICIENT OF HELIUM FROM THE SQUARE-WELL POTENTIAL. S.Kaneko and T.Kihara.
J. Phys. Soc. Japan, Vol. 11, No. 5, 471-3 (May, 1956).

The second virial coefficient of helium at low temperatures has been investigated by use of the square-well model of the intermolecular potential for a systematic set of potential parameters. A.

533.75 : 536.71

4895. AN APPARATUS FOR THE DETERMINATION OF EQUATIONS OF STATE OF GASES UNDER HIGH PRESSURES AND AT HIGH TEMPERATURES. J.Saurel and B.Vodar.
J. Rech. Cent. Nat. Rech. Sci., No. 33, 386-92 (Dec., 1955). In French.

The apparatus, which uses internal heating, is described with special reference to electrical and thermal insulation and uniform temperature distribution for the Amagat-type piezometer (several $cm^3$ useful volume). Temperature is measured by a Pt—Pt.Rh thermocouple, and volume changes of gas by a high-frequency proximity method using Hg column. The gas to be investigated, which is also the pressure medium, is introduced into the piezometer at high pressures. Preliminary results for $N_2$ and A up to $1000^0$ C and 1000 atm. are given, together with a discussion of the accuracy of measurements. F.Ansbacher

## VIBRATIONS. ACOUSTICS 534

534.11/.12

4896. EQUIVALENT LAY-OUTS FOR ELEMENTS OF OSCILLATORY SYSTEMS WITH DISTRIBUTED CONSTANTS. I.G.Rusakov.
Akust. Zh., Vol. 1, No. 3, 272-3 (1955). In Russian.

The author considers how to represent components of oscillatory systems with distributed constants, e.g. rods, membranes, tubes etc. over certain frequency ranges, by means of elements with concentrated characteristics. C.R.S.Manders

534.112

4897. NEW RESEARCHES CONCERNING THE VIBRATION OF THE STRINGS OF THE VIOLONCELLO. B.Bladier.
J. Phys. Radium, Vol. 16, No. 12, 1088 - 110S (Dec., 1955). In French.

Reference is made to an earlier paper (Abstr. 5353/1954) describing a study of the influence of pressure and velocity of the bow on the velocity of vibration of the wire-wound loaded strings (66 c/s). In the present paper this investigation has been continued using a spectrum-analyser as a means of studying the change of quality of the sound produced by changes of bowing pressure and velocity. Reproductions of the observed sound spectra illustrate the enrichment of the "timbre produced" by increase of bowing pressure and the reverse effect, "impoverishment" of timbre, due to increase of bowing speed. These effects are particularly noticeable on the amplitudes of the higher partials. A.B.Wood

534.142.

4898. THE CONDITIONS FOR SELF-EXCITATION OF A SINGING FLAME. Yu.I.Neĭmark and G.V.Aronovich.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 567-78 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 475-83 (Nov., 1955).

Singing flame stability is investigated on the basis of Rayleigh's interpretation, taking into account combustion delay. Three models of increasing complexity are proposed: a discrete model, a semidistributed model, and a distributec model (neglecting convection). The results are in good qualitative agreement with the known experimental facts, the distributed model describing the phenomenon most completel A.Gelbtuc

534

4899. ON CERTAIN SECOND-ORDER QUANTITIES IN ACOUSTICS. N.N.Andreev.
Akust. Zh., Vol. 1, No. 1, 3-11 (1955). In Russian.

Density and flux of sound energy, momentum, and pressure of sound radiation are examined fundamentally. Th method of successive approximations for first and second order is the accepted basic process of discussion of these problems, but in doing this it is considered essential to distinguish between the standpoints of Lagrange and Euler. The views of the author on density and flux of sound energy are a variance with the usual views. It appears that a full solution of the above topics requires fuller examination of boundary conditions. The author develops an example at length to illu trate his points. C.R.S.Mande

534.2 :539.

4900. APPLICATION OF A COMPOSITE PIEZOELECTRI VIBRATOR FOR INVESTIGATING MECHANICAL PROPERTIES OF POLYMERS. I.G.Mikhaĭlov and V.A.Solov'ev.
Akust. Zh., Vol. 1, No. 4, 343-7 (1955). In Russian.

The composite vibrator method in the usual form is not suitable for investigating materials with high loss and low ve city of sound such as polymers. The authors have shown it t be feasible to work with specimens of smaller cross-section than that of the piezo-crystal; some results are given. Elas tic anisotropy in stretched samples of vinyl plastic has been detected by this method. C.R.S.Mande

534.2 : 539.

4901. A METHOD OF MEASURING THE MECHANICAL PARAMETERS OF RUBBER AT SONIC AND ULTRASONIC FREQUENCIES. V.V.Tyutekin.
Akust. Zh., Vol. 1, No. 4, 356-9 (1955). In Russian.

The paper describes a method for determining the mech anical parameters over a continuous frequency band. The elastic modulus and loss coefficient can be measured for shear strains over a frequency range 4-50 kc/s. C.R.S.Mande

534

4902. STRESS WAVES IN SOLIDS. R.M.Davies.
Brit. J. appl. Phys., Vol. 7, No. 6, 203-9 (June, 1956).

Discusses in fairly elementary fashion, the topic of the transmission of transient stress pulses of short duration in solids, together with the associated problem of the measure ment of pressures subject to very rapid changes. The press bar method, devised by Bertram Hopkinson, forms one of th basic experiments in the field and it is described in some detail. An analysis of the limitations of the method leads to a discussion of the change of form of stress wave pulses as they recede from the origin, and the main features of the distortion are discussed when the pulses are propagated in (a) elastic solids, (b) visco-elastic solids, and (c) solids stressed beyond the elastic limit.

534.2

903. THE PROPAGATION AND REFLECTION OF SOUND 'ULSES OF FINITE AMPLITUDE. T.F.W.Embleton. 'roc. Phys. Soc. B, Vol. 69, Pt 3, 382-95 (March 1, 1956).

Experimental results are discussed covering many aspects f the propagation and reflection of finite amplitude sound ulses and weak shock fronts. These are compared with theory nd show amongst other features (a) that an N-shaped wave orm tends to shorten on reflection and (b) that a shock front isappears on reflection at an open-ended tube. A.

534.213

904. THE CORRELATION OF FLUCTUATIONS OF MPLITUDE AND PHASE DURING PROPAGATION OF A VAVE IN A MEDIUM WITH RANDOM HETEROGENEITIES. .A.Chernov.

kust. Zh., Vol. 1, No. 1, 89-95 (1955). In Russian.

The paper is almost entirely theoretical. A method is iven for calculating the correlation of amplitude and phase at given receiving point. For large-scale heterogeneities it is hown that self-correlation between fluctuations of amplitude or phase) at various receiving points extends to a distance of he same order as for correlation between fluctuations of re- ractive index in the medium. C.R.S.Manders

534.213

905. AN INVESTIGATION INTO THE PROPAGATION OF LTRASONIC WAVES IN THE CRITICAL REGION OF A IQUID-VAPOUR SYSTEM. V.F.Nozdrev.

kust. Zh., Vol. 1, No. 3, 235-48 (1955). In Russian.

Following a brief description of the experimental pecuri- ties of studying propagation of sound in the critical region, he paper brings together experimental material concerning elocity of propagation and adiabatic compressibility in the ritical region for organic substances, both following the aturation curve and with superheated vapours when $\rho = \rho_{crit.}$ n indirect method is suggested of determining the velocity f sound at the critical point. From ultrasonic data Cp, Cv nd the ratio Cp/Cv are calculated in the critical region whilst p is determined directly at the critical point. Results are iscussed in terms of thermodynamic considerations. 15 refs. C.R.S.Manders

534.213

906. THE PROBLEM OF INTERACTION OF SOUND VAVES. A.G.Gorelik and V.A.Zverev.

kust. Zh., Vol. 1, No. 4, 339-42 (1955). In Russian.

A method similar to that of I.L.Bershtein can be employed or detecting and studying acoustic wave interaction in fluids. he very small modulation caused by this interaction can be etected but its amplitude and phase can also be determined. C.R.S.Manders

534.213 : 551.46

907. AN ESTIMATE OF THE EFFECT OF TURBULENCE N THE OCEAN ON THE PROPAGATION OF SOUND. .A.Knauss.

. Acoust. Soc. Amer., Vol. 28, No. 3, 443-6 (May, 1956).

A hydrophone monitoring a constant-level sound source n the open ocean records a sound whose intensity fluctuates ver short periods of time. Previously it has been demonstra- ed that much of this fluctuation can be accounted for by the emperature microstructure. It has been suggested that nother cause of the observed fluctuation could be inhomogen- ities in the velocity field (turbulence). This paper is an ttempt to estimate the magnitude of turbulence in the ocean. he conclusion is reached that turbulence contributes very ittle to the fluctuation observed in the intensity of underwater ound signals. A.

534.213 : 534.22

908. APPARATUS FOR THE STUDY OF THE PROPAGA- ION OF ULTRASOUND IN HIGHLY COMPRESSED GASES. .Noury.

J. Phys. Radium, Vol. 17, No. 2, 166 (Feb., 1956). In French.

A description is given of a high-pressure steel 'bomb' designed for the study of the velocity of ultrasound in the critical region of highly compressed gases, using the diffraction of light method devised by Lucas and Biquard. The bomb is a massive steel cylindrical vessel pierced by holes along and at right angles to the axis of revolution. Details are given necessary to the fitting in these holes of the supply of high-pressure gas and the ultrasonic and optical equipment used in making the velocity measurements. Pressures up to 1200 atmospheres are attainable, at a temperature of 25°C. A.B.Wood

534.22/.23

4909. THE GENERAL CONNECTION BETWEEN ABSORPTION AND DISPERSION. V.L.Ginzburg.

Akust. Zh., Vol. 1, No. 1, 31-9 (1955). In Russian.

This same topic is discussed first in application to the propagation of electromagnetic waves and results known previously are obtained. Next analogous formulae are derived connecting velocity and sound absorption coefficient. Lastly the peculiarities distinguishing the acoustic case from the electromagnetic are discussed. C.R.S.Manders

534.22

4910. ULTRASONIC DISPERSION IN A $CO_2$—$H_2O$ MIXTURE. F.A.Gutowski.

J. Acoust. Soc. Amer., Vol. 28, No. 3, 478-83 (May, 1956).

The velocity of ultrasonic waves was measured in $CO_2$ containing a 0.01 mole-fraction of water vapour at the frequencies 1001.8 kc/s and 540.6 kc/s in the range from 0.5 Mc/s per atmos. to 6 Mc/s per atmos. at 35.1°C. The mixture was prepared at one fixed $CO_2$ and $H_2O$ pressure to give greater assurance of constant composition and was analysed for water content by gravimetry. Variation of pressure within the interferometer was obtained by varying the rate of flow with a precision needle valve. Complete symmetry of current peak structure and hence a more accurate determination of wavelength was obtained by the technique of continually compensating for frequency shift due to the variation of acoustic impedance of the gas column. The velocity was found to vary from 286.2 m/sec at 6 Mc/s per atmos. to 278.1 m/sec at 0.5 Mc/s per atmos. The experimental points fit the curve for a single relaxation time of $3.03 \times 10^{-7}$ sec corresponding to an inflection frequency of 740 kc/s per atmos. A.

534.22 : 533.7

4911. THE SPEED OF SOUND IN GASES UNDER PRESSURE AND VIRIAL COEFFICIENTS. A.Lacam and R.Bergeon.

J. Rech. Cent. Nat. Rech. Sci., 349-51 (Dec., 1955).

An expression is derived for the square of the velocity of sound in a gas under pressure, in the form of a series of powers of the density of the gas, which is assumed to obey the Lennard-Jones theoretical equation of state of a fluid; the coefficients in the series are directly related to the virial coefficients of the gas which extend as far as the 4th virial coefficient. Satisfactory agreement is found between theoretical and experimental values relating to argon, nitrogen and methane. J.S.G.Thomas

534.22

4912. ON ANOMALOUS, NONLINEAR SOUND DISPERSION IN FATTY ACIDS. E.Hiedemann and W.Mayer.

Naturwissenschaften, Vol. 43, No. 6, 123 (1956). In German.

Using an impulse method with palmitic acid the authors find that the velocity increases very definitely with intensity. The results confirm those found by other workers (See Abstr. 1671, 2464/1951) using an interference method. T.C.Toye

534.23

4913. ONE PARTICULAR FORM OF ATTENUATION IN WAVE PROPAGATION IN LAMELLAR NONUNIFORM MEDIA. L.M.Brekhovskikh and I.D.Ivanov.

Akust. Zh., Vol. 1, No. 1, 23-30 (1955). In Russian.

The propagation is considered of waves in a layer bounded

on one side by a nonuniform medium in which the velocity of propagation falls off with distance from the layer boundary. It is shown that in these conditions propagation is associated with an additional weakening caused by energy being "siphoned off" from the waves into the nonuniform medium. The full theory of the effect is given and its magnitude determined.
C.R.S.Manders

534.23 : 532.7

4914. ULTRASONIC ABSORPTION IN CASTOR OIL: DEVIATIONS FROM CLASSICAL BEHAVIOR. B.J.Wuensch, T.F.Heuter and M.S.Cohen.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 311-12 (March, 1956).

An excess absorption has been observed in castor oil by pulse propagation measurements. It is most pronounced at the higher temperatures and the lower frequencies of the range investigated. A.

534.23

4915. VIBRATIONAL RELAXATION IN $N_2O$–$H_2O$ AND $N_2O$–$D_2O$ MIXTURES. H.M.Wight.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 459-61 (May, 1956).

Ultrasonic absorption measurements were made to compare the relative effectiveness of $H_2O$ and $D_2O$ molecules in influencing thermal vibrational relaxation in $N_2O$ molecules. The displacement rates of the absorption per wavelength maxima induced by $H_2O$ and $D_2O$ were compared in $N_2O$–$H_2O$ and $N_2O$–$D_2O$ mixtures. Experimental apparatus was constructed for these measurements which utilized the "direct" absorption technique in conjunction with pulsed sound waves, having a frequency of approximately 113 kc/s. The parameter of frequency/pressure was varied by changing the gas pressure. The data were taken at a temperature of 21°C in the frequency/pressure range of 100-700 kc/s per atmos. The maximum amplitude of the molecular absorption coefficient per wavelength in dry $N_2O$ was 0.153 and this occurred at 210 kc/s per atmos. Measurements were taken in $N_2O$–$H_2O$ and $N_2O$–$D_2O$ mixtures at $H_2O$ vapour and $D_2O$ vapour concentrations of 0.39%, 0.77% and 1.14%. The usual single relaxation time theoretical absorption curve could be fitted to the data for dried $N_2O$. However, in the mixtures there was some evidence of two separate relaxation times, one possibly associated with $N_2O$–$N_2O$ collisions and the other with $N_2O$–$H_2O$ or $N_2O$–$D_2O$ collisions. The maximum absorption coefficient in the mixtures was somewhat less than that observed in the dried $N_2O$. The $H_2O$ molecules were 1.72 times more effective than the $D_2O$ molecules in shifting the frequency associated with the absorption maximum. A.

534.23

4916. ABSORPTION OF SOUND IN MANGANOUS SULFATE SOLUTIONS. J.R.Smithson and T.A.Litovitz.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 462-8 (May, 1956).

The absorption of sound in $MnSO_4$ solutions was studied over the frequency range 1 to 55 Mc/s as a function of concentration, temperature, dielectric constant, and with $D_2O$ as solvent. The absorption maximum in the range 1 to 10 Mc/s was verified, and also a secondary relaxation peak, not previously reported, was observed near 30 Mc/s. The primary relaxation frequency was decreased when the dielectric constant was lowered, while the secondary relaxation frequency was increased. The absorption cross-section was increased when the dielectric constant was decreased. The primary relaxation frequency increased with increasing temperature following Arrhenius' equation. The activation energy was determined for both isodielectric and isocomposition solutions. Substitution of $D_2O$ as a solvent had no effect on the primary relaxation frequency but increased the absorption cross-section. The secondary relaxation was not observed in $D_2O$ solutions. These results indicate that the hydrogen ion is not involved in the rate-determining reaction causing the observed relaxation effects. Furthermore, the results seem to rule out the reaction between two ions of unlike sign as the rate determining step in the primary relaxation process and to make the reac between ions of like sign improbable. All observed data can explained on the assumption that the reaction is between two dipole molecules.

534.23 : 532.

4917. ON THE ABSORPTION OF ULTRASOUND BY SOLU TIONS OF MACROMOLECULES. R.Cerf and G.Laville.
J. Chim. phys., Vol. 53, No. 3, 292-4 (March, 1956). In Fr

The authors show how a high-frequency method may be used to measure the resistance of the quartz. It is shown th this resistance is very sensitive to the presence of quite sm quantities of macromolecules in the solution. The work has carried out on polystyrene in benzene. T.C.To

534.

4918. DETERMINATION OF THE ULTRASONIC ABSORP ION COEFFICIENT IN LIQUIDS BY THE THERMAL METH E.Grossetti.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 673-6 (April, 1956)

A discussion of the difficulties of measurement for high absorbing liquids. A method for obtaining consistent values is shown. T.C.To

534.23 : 537.312.

ULTRASONIC ATTENUATION IN SUPERCONDUCTING INDIUM. See Abstr. 4415

534.2

4919. REVIEW OF METHODS FOR RENDERING ULTRA- SONIC FIELDS VISIBLE. L.D.Rozenberg.
Akust. Zh., Vol. 1, No. 2, 99-109 (1955). In Russian.

The paper divides methods into three types: methods using the basic parameters of a sound field; methods using quadratic effects; methods using secondary effects. Well illustrated examples under each type are given. 45 refs.
C.R.S.Mande

534.2

4920. THE STUDY OF A SOUND SHADOW IN A MEDIUM WITH VERTICAL GRADIENT OF VELOCITY OF SOUND. A.N.Barkhatov.
Akust. Zh., Vol. 1, No. 2, 121-5 (1955). In Russian.

Attention is drawn to the possibility of setting up a patt in water of vertical distribution of velocity of sound on acco of variations of temperature and of hydrostatic pressure. phenomenon may be applied to the study of sound shadows; method is described. C.R.S.Mande

534.2

4921. A CAPACITATIVE ANALYSER OF A SOUND FIEL V.A.Zverev, V.M.Bokov and N.E.Lur'e.
Akust. Zh., Vol. 1, No. 3, 218-20 (1955). In Russian.

An experiment is described in which the sound field in liquid is investigated by means of the variation of the permi tivity with pressure in the medium. In water a change of pe mittivity at 5 Mc/s of the order of $10^{-6}$ is obtained for a sou frequency 85 kc/s and pressure change of $10^9$ bars.
C.R.S.Mande

534.

4922. THE MEASUREMENT OF NONLINEAR DISTORTIO IN LOUDSPEAKERS BY THE METHOD OF SUBSONIC MOD LATION. V.G.Belkin.
Akust. Zh., Vol. 1, No. 1, 12-22 (1955). In Russian.

The usual methods of measuring nonlinear distortions difficult to apply to loudspeakers owing to the wide variatio of their frequency characteristics. The suggestion is made that the nonlinear distortions can be estimated by exciting loudspeakers at both sonic and ultrasonic frequencies and t measuring the oscillations of sound pressure caused by dis placement of the moving system at subsonic frequency.
C.R.S.Mand

534.232

923. THE PROBLEM OF OSCILLATIONS ALONG THE THICKNESS OF POLARIZING SLABS OF BARIUM TITANATE. P.Golyamina.
Akust. Zh., Vol. 1, No. 1, 40-7 (1955). In Russian.
An investigation is made into the variation of the modulus of electric impedance with frequency and the frequency dependence of radiation from slabs of barium titanate ceramic close to the natural frequency. It transpires that over this range the frequency characteristics show a series of maxima, the arrangement of which on the frequency scale is determined by the geometric parameters of the slab and does not depend upon anticipated nonuniformities. It is shown experimentally that the frequency dependence of the intensity of sound radiated from a slab has a single-value connection with the frequency characteristic of the electrical impedance. C.R.S.Manders

534.232

924. SOUND RADIATION BY THE OSCILLATORY FACES OF AN ARBITRARY WEDGE. I. G.D.Malyuzhinets.
Akust, Zh., Vol. 1, No. 2, 144-64 (1955). In Russian.
Using the Sommerfeld integral, an exact solution is obtained in a wedge-shaped region for the acoustic pressure field which is caused by the oscillations of the faces. The case is examined in greater detail when the oscillation velocity at each of the two faces is constant. A connection is pointed out between solutions of the given problem and the problem of diffraction at a solid wedge. C.R.S.Manders

534.232

925. SOUND RADIATION BY THE OSCILLATORY FACES OF AN ARBITRARY WEDGE. II. G.D.Malyuzhinets.
Akust. Zh., Vol. 1, No. 3, 226-34 (1955). In Russian.
Using the exact solution obtained already for the sound pressure brought about by the oscillation of the faces of a wedge, it is shown that the rib has no effect on the radiated sound power which is exactly determinable by rules of geometric acoustics. C.R.S.Manders

534.232

926. CINE-THEATRE LOUD SPEAKER WITH DIFFUSING SOUND LENS. B.G.Belkin.
Akust. Zh., Vol. 1, No. 3, 200-2 (1955). In Russian.
Describes a two-band equipment, the h.f. emitter of which has a diffusing sound lens of variable refractive index. C.R.S.Manders

534.232

4927. ON THE CALCULATION OF A RIBBON MICROPHONE. A.V.Rimskiĭ-Korsakov.
Akust. Zh., Vol. 1, No. 3, 257-63 (1955). In Russian.
The paper considers first how to obtain the most favourable dimensions of ribbon microphone moving element pressure gradient for a given volume, given characteristics of the magnet and for given frequency distortion. Formulae are derived for the area and thickness of the ribbon and for the maximum sensitivity of the instrument. C.R S.Manders

534.232

4928. THE OBTAINING OF ULTRASONIC RADIATION OF CONSTANT INTENSITY WHEN IRRADIATING IN A VESSEL WITH UNTUNED BOTTOM. I.V.Skards.
Akust. Zh., Vol. 1, No. 3, 274-85 (1955). In Russian.
The problem arises out of irradiating specimens contained in an ampoules, when, unless precautions are taken, standing waves can be set up between the radiator and the bottom of the ampoule and, in addition, alteration of the spacing between radiator and the bottom of the vessel will alter the intensity of irradiation of the specimen. The author has designed a layout that has given constancy of irradiation intensity to within 4%. To achieve this the resistance of the ultrasonic generator was made equal to the sum of the internal resistance of the h.f. oscillator and resistance due to radiator losses. The required internal resistance is obtained by a mutual detuning of the output valve stage of the oscillator and the circuit of the quartz radiator. C.R.S.Manders

534.232

4929. AN ELECTROACOUSTIC CONVERTER FOR MAKING SOUND IMAGES VISIBLE. P.K.Oshchepkov, L.D.Rozenberg and Yu.B.Semennikov.
Akust. Zh., Vol. 1, No. 4, 348-51 (1955). In Russian.
The paper describes a device with a barium titanate receiving element, having an operating threshold of $3 \times 10^{-9}$ volt/cm$^2$ at low megacycle frequencies and a sensitivity of $2 \times 10^{-8}$ volt per bar. Functioning is linear over the range $3 \times 10^{-9}$-$3 \times 10^{-3}$ volt/cm$^2$. C.R.S.Manders

534.232

4930. DIRECTIONAL CIRCULAR ARRAYS OF POINT SOURCES. W.Welkowitz.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 362-6 (May, 1956).
The Fourier series solution for the radiation field of a circular pressure ring is applied to the synthesis of a sound field expressed in the form of a Chebyshev polynomial. This leads to an exact solution in closed form for the amplitude and phase of excitation of point source elements on a circle when the main lobe width of the radiation pattern, the side lobe suppression, and the array circle diameter are specified. Calculations are carried out for two sample beam patterns to show the effects of different choices of array circle diameter and number of point source elements. A.

534.232

4931. THE CONVERSION EFFICIENCY OF A PIEZOELECTRIC QUARTZ CRYSTAL: RELATION BETWEEN INPUT ELECTRICAL POWER AND FREQUENCY. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 145, No. 3, 368-72 (1956).
It is found that the efficiency is dependent not on the input power but on frequency and the nature of the liquid. A.

534.232

4932. EFFICIENCY OF SEVERAL QUARTZ CRYSTALS OSCILLATING AT ONE FREQUENCY. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 145, No. 3, 373-6 (1956).
The efficiency of conversion of electrical energy to ultrasonic energy of two quartz crystals oscillating at the same frequency but at different harmonics have been measured. It is found that excitation of a quartz crystal in a higher harmonic is accompanied by a lowering of the conversion efficiency. A.

534.24/.25

4933. THE SOLUTION OF AN INVERSE PROBLEM IN GEOMETRICAL ACOUSTICS. B.E.Kinber.
Akust. Zh., Vol. 1, No. 3, 221-25 (1955). In Russian.
The problem is considered of two reflecting, or two refracting surfaces, by means of which a given field can be transformed into another given field. The full set of differential equations for the problem is obtained. A solution is worked out assuming the correctness of the laws of geometrical acoustics (or optics). C.R.S.Manders

534.24

4934. REFLECTION OF AN ACOUSTICAL PRESSURE PULSE FROM A LIQUID–SOLID PLANE BOUNDARY. T.W.Spencer.
Geophysics, Vol. 21, No. 1, 71-87 (Jan., 1956).
The problem treated is concerned with predicting the transient response of a system composed of a liquid layer, bounded above by a vacuum and below by a perfectly elastic solid, when excited by an arbitrary pressure applied uniformly over the surface of a spherical cavity located in the fluid. The Laplace transform of the displacement response is expressed in terms of an integral which is expanded in such a way that

each term describes the contribution from one of the image sources. Each term may be evaluated exactly at points located on a vertical axis passing through the source. The final expression for the vertical displacement at axial points is composed of the acoustic, after-flow, and correction terms. In solids for which Poisson's ratio is greater than one third the initial variation of the correction is toward positive values (corresponding to motion directed toward the interface). For Poisson's ratio less than one third the initial variation may be either positive or negative depending on the magnitude of the compressional velocity ratio. A surface wave is shown to exist regardless of the choice of parameters. The surface wave velocity is always less than it would be in the absence of the liquid. A.

534.25

4935. A CALCULATION OF THE AMPLIFICATION OF CYLINDRICAL SOUND FOCUSING SYSTEMS. L.D.Rozenberg.
Akust. Zh., Vol. 1, No. 1, 70-7 (1955). In Russian.

General expressions are derived for the amplification and focusing factors of a convergent cylindrical front. It is shown that for maximum value of the pressure focusing factor the optimum distribution function takes the form: $\Phi(\alpha) = 1$, whilst for velocity $\Phi(\alpha) = \cos\alpha$. In sundry concrete cases the magnitudes of $K_p$, $K_v$, $\kappa$, $\kappa'$ are worked out; also the manner of their dependence upon the angular aperture of the front. The results may be applied to the computation of real focusing systems with an error not exceeding 10%, with exclusion of terminal sections of length $\sqrt{\lambda}f$. C.R.S.Manders

534.25

4936. DIRECTIONAL PROPERTIES OF SOUND DIFFUSING LENSES. L.N.Bondareva and M.I.Karnovskiĭ.
Akust. Zh., Vol. 1, No. 2, 126-33 (1955). In Russian.

Angular distributions are calculated of the sound pressures set up by plano-elliptical and plano-hyperbolic sound lenses for various values of refractive index, angular aperture and distance from the virtual focus of the lens. C.R.S.Manders

534.26

4937. EXPERIMENTAL STUDY OF THE DIFFRACTION OF SOUND WAVES ON PERIODIC STRUCTURES. A.N.Leporskiĭ.
Akust. Zh., Vol. 1, No. 1, 48-57 (1955). In Russian.

A description is given of experimental methods. Curves are given for the scattering from sinusoidal and serrate surfaces and compared with theoretical ones derived by means of a theory developed by L.M.Brekhovskiĭ. C.R.S.Manders

534.26

4938. SCATTERING OF SOUND FROM A PLANE NON-UNIFORM SURFACE WITH PERIODICALLY VARYING ACOUSTIC CONDUCTIVITY. Yu.P.Lysanov.
Akust. Zh., Vol. 1, No. 1, 58-69 (1955). In Russian.

A method is put forward for calculating sound scattering from a plane nonuniform surface characterized by a normal impedance or acoustic conductivity independent of the angle of incidence of the sound wave. The solution of the problem is given in the form of a series. Paper is entirely theoretical. C.R.S.Manders

534.26

4939. DIFFRACTION OF A PLANE SOUND WAVE AT A SPHERICAL CAVITY. D.V.Sivukhin.
Akust. Zh., Vol. 1, No. 1, 78-88 (1955). In Russian.

A solution is given for the problem. When the dimensions of the cavity are of the same order as the length of a transverse wave pronounced resonance is observed. A general equation is derived for the effective scattering cross-section. Scattering is also studied for both spherical and dipole waves whilst absorption is investigated in the first case only. C.R.S.Manders

534.

4940. DIFFRACTION OF SOUND AT A THIN FINITE PLA IN A LIQUID. L.M.Lyamshev.
Akust. Zh., Vol. 1, No. 2, 138-43 (1955). In Russian.

Discusses the problem of diffraction of sound at a thin plate in a liquid, taking into account longitudinal and flexural oscillations of the plate. It is shown that for certain angles incidence of the sound wave, passage of sound through the pl is observed, also strong scattering in direction with reverse direction of the incident wave, the so-called non-specular re flection. The paper is entirely theoretical. C.R.S.Mande

534.3

4941. OBSERVATIONS ON THE VIBRATION OF THE INDIAN PLUCKED STRING INSTRUMENT, "TANPURA". K.L.Bhattacharyya, B.K.Ghosh and S.K.Chatterjee.
Naturwissenschaften, Vol. 43, No. 5, 103-4 (1956).

534.442 : 621.317.7

4942. ACOUSTIC ANALYSERS. J.Sommer.
Arch. tech. Messen, Issue No. 240, (Ref. V 51-3), 1-4 (Jan., 1956). In German.

A review of methods of determining frequency spectra a harmonic contents of single tones, complex musical or speec waveforms, noise etc. in the a.f. range. Among the circuits discussed are tunable bridge and switched fixed filter distortion meters, a variable filter analyser for musical tones in which the component frequencies are measured by a Lissajou figure method against standard frequencies, a stroboscopic disk method in which the disks are illuminated by a gas discharge tube driven by the input signal, and various heterodyn methods using a fixed intermediate filter. One analyser with extremely high resolution, has automatic frequency control. Automatic recording systems are described and the limitatio on the frequency sweep speed due to finite filter response tim is discussed. 25 references are given. W.G.Stripp (

534.6 : 534.321.9

4943. THE MEASUREMENT OF ACOUSTIC PARAMETER OF MATERIALS AT ULTRASONIC FREQUENCIES USING AN IMPULSE TUBE. N.S.Ageeva.
Akust. Zh., Vol. 1, No. 2, 110-20 (1955). In Russian.

An account is given of a method for the measurement of the complex coefficient of reflection for ultrasounds from a plane surface making use of a hydroacoustic installation term an 'impulse tube'. With various forms of specimen (sheet, r etc.) the equipment has been successfully used for the determination of acoustic parameters, input impedance, coefficie of elasticity for various types of strain, velocity of propagati of sound in liquids etc. It is also possible to measure the so insulation given by sheets of material. The design of the app ratus allows measurements to be carried out at various temp ratures. C.R.S.Mander

534.61

4944. SURVEY OF METHODS OF ESTIMATING AND MEASURING THE DIFFUSENESS OF A SOUND FIELD. V.V.Furduev.
Akust. Zh., Vol. 1, No. 4, 299-314 (1955). In Russian.

A general review of the topic discussing such matters as statistics of natural oscillations, frequency irregularity, directional diffuseness, diffuseness and clarity, the role of t measuring signal. C.R.S.Mander

534.614 : 534.6

4945. THEORY OF A RESONANCE METHOD TO MEASURE THE ACOUSTIC PROPERTIES OF SEDIMENTS. W.J.Toulis.
Geophysics, Vol. 21, No. 2, 299-304 (April, 1956).

The theory of resonance for a pressure release cylindri chamber is explored and equations are derived for determini absolute values of the velocity of sound and the attenuation co stant in sediment samples. The essential measurements that

need to be made are the determination of the frequencies of the lower modes of resonance and the associated sharpness of resonance. Corrections are derived also for the finite thickness and the acoustic losses in the chamber walls. A.

534.614 : 534.62

4946. A RESONANT CHAMBER METHOD FOR SOUND VELOCITY AND ATTENUATION MEASUREMENTS IN SEDIMENTS. G.Shumway.
Geophysics, Vol. 21, No. 2, 305-19 (April, 1956).

Sound velocity and attenuation measurements in unconsolidated marine sediments have been made by a resonance method which utilizes a thin-walled plastic cylinder as a pressure-release container to hold samples. Velocities were determined from resonant frequencies which lay between 23 and 36 kc/s for the 2 in. diameter by 4 in. long cylindrical container used. Attenuation was determined from the sharpness of the resonant modes. Relatively undisturbed sediment samples were obtained by diver, in shallow water, using the same plastic containers in which the acoustic measurements are made. Deep sea samples were obtained by cutting sections from cores which were taken in plastic tubes. Velocities for shallow water sediments in the San Diego area ranged from 4840 ft/sec (0.978 times sea water velocity) for fine silt to 5680 ft/sec (1.147 times sea water velocity) for medium sand, measured at $60^{\circ}$ F and atmospheric pressure. Velocities in deep-sea red clay samples ranged between 0.980 and 1.040 times the sea water velocity, at $60^{\circ}$ F and atmospheric pressure. Attenuation coefficients for shallow-water San Diego sediments varied from about 1 to 4 dB/ft for silts, to about 3 to 8 dB/ft for sand. A.

534.62

4947. THE MEASUREMENT OF SOUND ATTENUATION IN AN ISOTHERMAL SURFACE LAYER OF WATER.
A.N.Barkhatov.
Akust. Zh., Vol. 1, No. 4, 315-20 (1955). In Russian.

Methods of investigating sound propagation in a laminar-inhomogeneous medium can be successfully employed for the study of sound attenuation in a surface, isothermal water layer providing there is a negative vertical gradient of sound velocity. Experimental results appear to be in good agreement with theory. C.R.S.Manders

534.64

4948. A METHOD OF MEASURING ACOUSTIC RESISTANCE BASED ON A MEASUREMENT OF THE GEOMETRIC DIFFERENCE OF ACOUSTIC PRESSURES. V.N.Fedorovich.
Akust. Zh., Vol. 1, No. 4, 360-7 (1955). In Russian.

A method is described of measuring acoustic resistance by observing the acoustic pressure differences at the outputs of two acoustic four-terminal networks, loaded by a meter and an infinitely large acoustic resistance, for the same acoustic pressures at the four-terminal inputs. Results are given of measurements, made with the apparatus described, of the acoustic resistances of a natural and an artificial ear. C.R.S.Manders

534.64

4949. SOME NOTES ON THE MEASUREMENT OF ACOUSTIC IMPEDANCE. O.K.Mawardi.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 351-6 (May, 1956).

The theory for a plane-wave method of measurement of acoustic impedance in a tube is worked out. The effect on the measurement of irregularities in the surface of the sample has also been investigated. It is shown that the measured impedance differs from that of the average impedance evaluated at the surface of the specimen. A number of recommendations for the method of preparation of a sample have also been given. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

4950. EFFECT OF REPETITION ON ARTICULATION SCORES FOR PB WORDS. E.J.Thwing.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 302-3 (March, 1956).

Naive listeners are administered PB (phonetically balanced) word articulation tests under four conditions of successive repetition and three conditions of signal-to-noise ratio. At all three signal-to-noise ratios, successive repetition of test words yields slightly higher articulation scores. The major portion of improvement in scores occurs with the second presentation; third and fourth presentations have negligible effect. A.

534.78

4951. INTELLIGIBILITY OF DIPHASIC SPEECH.
G.E.Peterson, E.Sivertsen and D.L.Subrahmanyam.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 404-11 (May, 1956).

This study concerns the intelligibility of speech under various periodic switching operations. In diphasic speech the signal is separated into successive segments which are reversed in phase. The intelligibility of this speech was found to be high for switching frequencies below about 100 c/s; in the intermediate audio-frequency region the intelligiblity falls to very low values. Throughout this intermediate frequency region, the intelligibility of diphasic speech is markedly less than that of interrupted speech. Some explanation for this difference is found in the Fourier expansion for the two cases. In interrupted speech the original spectrum is retained, but in diphasic speech terms for the spectrum in its normal form do not appear. It was experimentally observed that throughout the intermediate frequency region binaural diphasic speech, in which the signal is switched alternately from one ear to the other, is more intelligible than monaural diphasic speech or interrupted speech. A.

534.83

4952. THE MEASUREMENT OF A CORRELATION COEFFICIENT. S.G.Gershman and E.L.Feĭnberg.
Akust. Zh., Vol. 1, No. 4, 326-38 (1955). In Russian.

The paper describes a device based on the relation between the correlation coefficients of two noises and the probability of coincidence of the signs of the instantaneous valuesof these noises. C.R.S.Manders

534.831

4953. A SUGGESTED AUDIOMETRY CARD AND IBM CODING SYSTEM FOR HEARING CONSERVATION PROGRAMS.
Noise Control, Vol. 1, No. 4, 28-33 (July, 1955).

534.837

4954. THE ACOUSTIC POWER OF THE NOISE CREATED BY THE ELEMENTS OF AIR HUMIDIFIERS. E.Ya.Yudin.
Akust. Zh., Vol. 1, No. 4, 368-82 (1955). In Russian.

Describes a method of investigating the noise arising in airflow through a channel. Some results are given. It is found that the acoustic power is proportional to the cube of excess pressure and the square of the geometric dimensions. The noise covers a very wide frequency band and has a statistical character. C.R.S.Manders

534.837

4955. JET NOISE PROBLEM IN AIRCRAFT CARRIER ISLANDS. A.C.Pietrasanta.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 427-33 (May, 1956).

Noise during jet aircraft launching operations seriously interferes with communications in important island spaces aboard aircraft carriers. Measurements of sound pressure levels made in these spaces during normal jet operations at sea are reported. It was found that these levels could be estimated from a knowledge of jet engine operating conditions (see abstract following) and the physical properties of the structures involved. The problem of the selection of criteria for speech communication is discussed. Noise reduction requirements for

island spaces, based on estimated noise levels of present and future jet aircraft, are presented. A.

534.837

4956. NOISE MEASUREMENTS AROUND SOME JET AIRCRAFT. A.C.Pietrasanta.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 434-42 (May, 1956).

The noise fields around several jet aircraft have been measured for various engine operating conditions. Directivity patterns as a function of octave bands of frequency are presented. Acoustic power levels have been computed and found to agree with a previously published correlation of power level with engine operating conditions (Abstr. 5361/1953). Analysis of these data has led to the development of a procedure for estimating the characteristics of the noise fields around non-afterburner jet aircraft operating at military power. A.

534.839

4957. NOISE MEASUREMENTS AT VERY HIGH LEVELS. A.Peterson.
Noise Control, Vol. 2, No. 1, 20-6 (Jan., 1956).

534.839

4958. AN EVALUATION TECHNIQUE FOR IMPACT-TYPE NOISES. H.C.Hardy, F.G.Tyzzer and H.H.Hall.
Noise Control, Vol. 2, No. 2, 38-41, 98 (March, 1956).

534.839

4959. APPARATUS NOISE MEASUREMENT. R.J.Wells.
Trans Amer. Inst. Elect. Engrs III, Vol. 74, 1170-3 (1955) = Pwr Apparatus Syst., No. 21 (Dec., 1955).

A new test code (U.S.A.) for this purpose will involve the measurement of (a) the total radiated acoustic power and (b) sound pressure level at specified locations. Of these (a) is primarily studied. Measurements can be made in (1) a free field, (2) a reverberant field, and (3) a semi-reverberant field. In all cases a space integration of the total sound power radiated is obtained and the results are expressed as a sound power level octave-band spectrum. In free space, (1), the recommended radius for the microphone array and the number of microphones required or, alternatively, the procedure for rotating the source are given. Two methods of calibrating a reverberant room, (2), are put forward, the relationship between room size and frequency range indicated and the necessary operating precautions stated. The use of free-space measurements to enable a semi-reverberant room, (3), to be employed is explained. In all cases the mathematical relationships are given. H.G.M.Spratt

534.839

4960. THE MEASUREMENT OF IMPACT NOISE. A.Peterson.
Noise Control, Vol. 2, No. 2, 46-51, 100 (March, 1956).

534.839

4961. TECHNIQUES FOR NOISE MEASUREMENT AND EVALUATION OF DATA. R.S.Gales.
Noise Control, Vol. 1, No. 3, 22-9 (May, 1955).

534.862.3/.4 : 534.76

4962. THE SECONDARY FIELD DURING STEREOPHONIC TWO-CHANNEL TRANSMISSION AND CERTAIN FIXED ARRANGEMENTS OF THE SOURCE OF SOUND IN THE PRIMARY FIELD. P.G.Tager.
Akust. Zh., Vol. 1, No. 3, 286-93 (1955). In Russian.

The article is a theoretical investigation devoted to the study of the two most important parameters of the secondary sound field which affect the stereophonic effect, viz. difference of energy levels from the two loud speakers perceptible to the hearer, and the perception of a time lag between the signals from these loud speakers. C.R.S.Manders

534.862.3 : 621.395.625.

4963. THE EFFECT OF MAGNETIC FIELD DISTRIBUTIO AT THE GAP OF A RECORDING HEAD ON THE LOSS OF RESIDUAL INDUCTION IN THE TAPE. G.S.Veksler.
Akust. Zh., Vol. 1, No. 2, 134-7 (1955). In Russian.

The paper investigates the dependence of the residual induction in a carrier of magnetic signals upon the rate of fall-off of magnetic field intensity of the recording head. A model is used for the magnetic process of recording, without taking into account the phenomena of spontaneous demagnetization and penetration. It is shown that with steepest falling off of intensity of magnetic field over the region through whic the tape runs the residual induction may rise to 5-6 dB. C.R.S.Manders (R

534.862.

4964. NONLINEAR DISTORTIONS OF A NON-PERIODIC SIGNAL IN AN ELECTROACOUSTIC PATH. A.V.Rimskiĭ-Korsakov.
Akust. Zh., Vol. 1, No. 2, 165-70 (1955). In Russian.

For an approximate evaluation of the nonlinear distortio in an electroacoustic path it is proposed to consider the trans mitted signal as a stationary random process and to calculate its spectral density on leaving from its spectral density on entry, and from the nonlinearity characteristic of the path. The particular cases of "right-angled" and "bell" spectra are considered in some detail and expressions given for the spectral density of nonlinear products of 2nd-3rd and 2nd-5th orders respectively. C.R.S.Mander

## OPTICS. RADIATION. SPECTRA 535

535.

4965. RESOLVING POWER OF VISIBLE LIGHT. J.A.O'Keefe.
J. Opt. Soc. Amer., Vol. 46, No. 5, 359 (May, 1956).

A concept is presented by which it might conceivably be possible to go beyond the resolving power of visible light. A particle whose size is to be measured is placed in front of a illuminated pinhole of size smaller than the wavelength of lig used. Movement of the particle across the pinhole can then b detected by the passage or non-passage of light, and by scan ning an image of the particle can be built up. R.W.Fl

535.22

4966. NEW DETERMINATIONS OF THE VELOCITY OF LIGHT. R.C.A.Edge.
Nature (London), Vol. 177, 618-19 (March 31, 1956).

Two determinations made by the Ordnance Survey in 195 and one by Schöldström in 1955 are compared, agreeing clos with Bergstrand's 1950 result. An AGA geodimeter was teste for the U.S. Army Map Service, by remeasuring the Ridge Way and Caithness base lines which are known to $< 1/10^8$ by previous Invar tape determinations. A filter was used passin light with a group wavelength of 5580 A, and the formula used to obtain the group refractive index in ambient conditions is quoted. The two modulating frequencies were twice checked by the N.P.L., to within $1/10^7$ of the American figures which were accepted for the calculations. The resulting value for the velocity of light is given as 299, 792.4 ∓ 0.11 km/sec (root mean square error). A table is given summarizing the important data. References to the other results are quoted. J.J.Phipp

535.23

4967. THE VARIATION WITH TEMPERATURE OF THE SPECTRAL EMISSIVITIES OF IRON, NICKEL AND COBALT L.Ward.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 339-43 (March 1, 1956).

The spectral emissivities were measured over a wave-

ength range 1.0 $\mu$ to 3.0 $\mu$ and at temperatures between 650° nd 1350° C. The results show anomalies in the cases of iron nd cobalt occurring at temperatures in the neighbourhood of he respective Curie points. Tables of the temperature coeffi- ients of emissivity for the three metals are given. A.

535.245.22 : 518.5

4968. NETWORK REPRESENTATION OF THE INTEGRA- TING SPHERE. P.F.O'Brien.
J. Opt. Soc. Amer., Vol. 46, No. 5, 343-5 (May, 1956).

The interreflected-flux distribution in an integrating sphere equipped with apertures for the introduction, reflection and absorption of radiant flux may be represented by a network. Sphere apertures of finite size, nonblack apertures and sphere ports defined by plane surfaces are represented in the network as resistance elements. For the case of black entrance and exit ports, an expression for the flux incident on the exit port is computed by circuit analysis and is identical to the expression derived by Jacques and Kuppenheim using the integral equation technique. A solution of the network representing a sphere with a nonblack exit port of various relative sizes is presented as obtained using a network analyser. A.

535.247.1

4969. A NEW SENSITIVE CHEMICAL ACTINOMETER. I. POTASSIUM FERRIOXALATE AS A STANDARD CHEMICAL ACTINOMETER. C.G.Hatchard and C.A.Parker.
Proc. Roy. Soc. A, Vol. 235, 518-36 (June 19, 1956).

The earlier experiments with potassium ferrioxalate have been extended and a detailed study has been made of the photolysis of the acidified solutions previously recommended for chemical actinometry (Pt I, Abstr. 1131/1954). Accurate values of quantum efficiency have been determined at twelve wavelengths between 254 and 578 m$\mu$, and the effect of temperature, light intensity and of photolyte composition have been investigated. At some wavelengths independent values of quantum efficiency have been obtained by comparison with uranyl oxalate and by direct comparison with a calibrated thermopile. The results indicate that potassium ferrioxalate provides a very valuable new chemical actinometer, and its use is recommended in place of uranyl oxalate for many purposes. Full working details for the use of the actinometer are provided. A.

535.317.25

4970. RESOLVING POWER AND INFORMATION. G.Toraldo di Francia.
Atti Fond. Ronchi, Vol. 10, No. 5, 347-55 (Sept.-Oct., 1955). In Italian.

The degrees of freedom of an image formed by a real optical instrument are finite in number, while those of the object are infinite. Thus several different objects may correspond to the same image, and, in the case of coherent illumination, a large class of objects corresponding to the same image can be easily found. Two-point resolution is impossible unless the observer has a priori an infinite amount of information about the object. R.W.Fish

535.317.5

4971. A CLASS OF CONFIGURATION LENSES CORRECTED FOR SPHERICAL ABERRATION OF FIFTH ORDER. D.Dorsi.
Atti Fond. Ronchi, Vol. 10, No. 6, 446-51 (Nov.-Dec., 1955). In Italian.

The passage of rays through certain configuration lenses (cones, cylinders) is traced, and conditions are found for the system to be free of spherical aberration. R.W.Fish

535.317.6

4972. THE APPROXIMATE REPRESENTATION OF CERTAIN ABERRATIONS BY BINOMIAL SERIES. M.T.Zoli.
Atti Fond. Ronchi, Vol. 10, No. 4, 267-78 (July-Aug., 1955). In Italian.

The field curvature, astigmatism and distortion of five systems have been represented by two terms of an infinite series, either of field angle, its sine or tangent. The best form of expression has been found for each case, but there is not always a simple rule for selecting the best type of expansion. R.W.Fish

535.317.9

4973. THE THEORY OF IMAGE FORMATION IN ANAMORPHIC SYSTEMS. H.Köhler.
Optik, Vol. 13, No. 4, 145-57 (1956). In German.

Now that anamorphic systems are in common use, a theory of the third-order aberrations is necessary. This paper reviews existing theories of the paraxial image formation and discusses in a general manner the basis of third-order theory. R.W.Fish

535.32

4974. ON A ONE-TERM APPROXIMATE FORM OF THE DISPERSION EQUATION FOR THE VISIBLE AND ULTRAVIOLET REGION. E.Kordes.
Naturwissenschaften, Vol. 43, No. 3, 52 (1956). In German.

The equation $(n^2 - 1)^2/(n_\infty^2 - 1)^2 = \nu_1^2/(\nu_1^2 - \nu^2)$ is found very satisfactory for KCl in the range 198-656 m$\mu$. G.F.Lothian

535.32 : 537.533.9 : 537.56

4975. A QUANTUM THEORY OF REFRACTIVE INDEX, ČERENKOV RADIATION AND IONIZATION LOSS. D.A.Tidman.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 503-4 (Feb., 1956).

The method of calculation, applying a certain transformation to the Hamiltonian of the electromagnetic field in a medium of atoms, and giving a quantum mechanical definition of the refractive index, is briefly outlined. W.A.Hepner

535.32 : 539.13

4976. ON THE THEORY OF THE REFRACTIVE INDEX OF NON-POLAR GASES. I. QUANTUM MECHANICAL PART. P. Mazur and M.Mandel.
Physica, Vol. 22, No. 4, 289-98 (April, 1956).

A quantum mechanical calculation is given for the effect of molecular interactions on the polarizability of spherical non-polar molecules in a periodic external electric field. The polarizability tensor is obtained from perturbation theory as a power series in the interaction tensor $T_{ik} = \nabla_i \nabla_k (1/r_{ik})$, where $r_{ik}$ is the distance between two molecules i and k. It is found that the constants $C_1$ and $C_2$, introduced by Jansen and Mazur in the static case (Abstr. 4856/1955) and characterizing the influence of molecular interactions on the polarizability, in order $T^2$, become now frequency dependent. This frequency dependence is explicitly evaluated for helium at frequencies of the incident wave small compared to the frequencies of the softest absorption line. A.

535.32 : 539.13

4977. ON THE THEORY OF THE REFRACTIVE INDEX OF NON-POLAR GASES. II. STATISTICAL PART. P.Mazur and M.Mandel.
Physica, Vol. 22, No. 4, 299-310 (April, 1956).

A statistical theory is given for the refractive index of non-polar gases at low densities, taking into account both the effect of statistical fluctuations and the effect of the variation of the polarizability due to molecular interactions. A generalized Lorentz–Lorenz formula is derived and numerical calculations are performed for helium. For the highest frequencies considered the correction to the Lorentz–Lorenz function is about 15% larger than the corresponding correction to the Clausius–Mosotti function. A.

535.33/.34 : 536.48

4978. APPLICATION OF LOW TEMPERATURES IN OPTICAL SPECTROSCOPY. P.Jacquinot.
J. Rech. Cent. Nat. Rech. Sci., No. 33, 345-8 (Dec., 1955). In French.

A general outline of research on this subject, carried out at the Aimé Cotton laboratory (Laboratoire du Grand Aimant et des Basses Temperatures). By reducing the Doppler effect, low temperatures reduce the line width, thus increasing the accuracy of measurements of phenomena due to the interaction between electron configurations and the nuclei. The Schüler "hollow cathode" and the recently developed photoelectric recording Fabry–Perot spectrometer ensure good results even with solids (Fe). The study of He lines (triplets) has been made possible by the use of very low temperatures (liquid $H_2$, liquid He, pumped liquid He). Besides several other instances of research where absorption spectroscopy of solids is involved, low temperatures help to study the Zeeman effect in the absorption lines of chrome alum. F.Lachman

535.33.03

4979. A SIMPLE MONITOR CIRCUIT FOR A SPECTROGRAPHIC A.C. ARC SOURCE. D.F.T.Roberts and E.H.S.van Someren.
J. sci. Instrum., Vol. 33, No. 6, 226-8 (June, 1956).

An inexpensive unit is described by means of which the form of the discharge voltage and current and the trigger pulses associated with a spectrographic a.c. arc are displayed, and their phasing determined with reasonable accuracy. The equipment utilizes a 1 in. type 1CP1 miniature self-focusing cathode-ray oscillograph. A 100 c/s time-base locked to mains frequency is used, with adjustable phase-angle marker "pips" to give a convenient display. A.

535.33.07

4980. COMPARISON OF VARIOUS INFRARED SPECTROMETRIC SYSTEMS. M.J.E.Golay.
J. Opt. Soc. Amer., Vol. 46, No. 6, 422-7 (June, 1956).

Several already known and several new spectrometric systems are compared from the viewpoint of noise factor, instrumental simplicity, and general performance. A.

535.33.07

4981. EFFECT OF ELIMINATION OF THE SPECULAR COMPONENT ON EFFICIENCY AND ERROR OF THE INTEGRATING SPHERE. J.A.Jacquez and H.F.Kuppenheim.
J. Opt. Soc. Amer., Vol. 46, No. 6, 428-9 (June, 1956).

Given a perfect comparison type integrating sphere and a standard with perfectly diffuse reflection, the black cups (as used on the General Electric recording spectrophotometer) for eliminating the specular reflection component cause a decrease of efficiency, do not affect the sphere error, but may increase the actual error because the total flux measured is decreased while the instrumental error remains constant. A.

535.33.07

4982. IMPROVED METHOD OF INTEGRATING CURVES OBTAINED ON A GENERAL ELECTRIC TYPE RECORDING SPECTROPHOTOMETER. E.Allen.
J. Opt. Soc. Amer., Vol. 46, No. 6, 430-3 (June, 1956).

A new method for hand-integration of curves obtained on a General Electric-type recording spectrophotometer has been developed for use where accurate results are desired. A retardation plate is used for constructing a wavelength grid by setting the pen at a maximum or a minimum of the transmission curve of the plate and then allowing the pen to travel up and down the paper. This makes available approximately 35 ordinates for the integration. The curve, plotted on semi-transparent paper, is aligned over the grid, and the reflectance or transmittance for each of the grid lines is read off. Each value is then multiplied by an appropriate factor, and the products are summed to give the tristimulus value. This method avoids the tedium and loss of precision of the usual method which makes use of a correction curve derived from the didymium peaks. Errors of paper positioning and irregularity in the wavelength cam will not affect the results by the proposed method. A.

535.33.

4983. SEMIAUTOMATIC METHOD FOR SPECTROSCOPIC WAVELENGTH AND INTENSITY MEASUREMENTS. G.H.Dieke, D.Dimock and H.M.Crosswhite.
J. Opt. Soc. Amer., Vol. 46, No. 6, 456-61 (June, 1956).

An arrangement is described by which spectroscopic wa length measurements are greatly simplified with an increase accuracy. The measuring microscope is replaced by a photc electric scanning device which displays line contours on an oscilloscope screen. The comparator readings are made aut matically with electronic devices, and the results either recorded with an automatic typewriter or punched into cards o both. Photographic densities are measured and recorded at same time. The data are then further processed by electron calculating machines. The equipment is built largely from commercially available components. Its operation is simple and foolproof. The various stages are independent of each ot and can be introduced singly or in combination as desired.

535.33.07 : 535.4

4984. CALCULATION OF THE ELEMENTS OF A FABRY–PEROT SPECTROMETER CAPABLE OF STUDYIN AN EXTENDED SPECTRUM. R.Chabbal.
J. Rech. Cent. Nat. Rech. Sci., 352-63 (Dec., 1955).
In French.

The use of a Fabry–Perot interferometer (FP) in a spe trometer has great advantages in respect of resolving power and light flux, but to ensure adequate purity of the transmitt band the parasitic peaks must be suppressed by a premono- chromator. Calculation shows that a slit-type instrument wi grating or prism as premonochromator needs very large co ponents to supply a single FP with enough light, but a secon FP of shorter path can be used instead. A chain of several can be used to isolate a very narrow band, though parasitic peaks are only reduced by this system. Calculations are ma to determine the filtering factor, or percentage of useful energy arriving at the detector, and it is shown that adequat filtering requires k/N to be of the order of 0.1, where k is t ratio of path-lengths of the two FP and N is the coefficient o finesse of the monochromator FP (say k = 8, N = 80). Surfa defects do not prevent the attainment of a satisfactory filteri factor. Inter-reflections between two FP may degrade contrast, but this is largely eliminated by slightly non-axial arrangements, and the overall transparency can still show large gain over a grating instrument. The association of a grating with a chain of FP is discussed, with numerical dat show the utility of various combinations in respect of resolv ing power, overall finesse, flux transmitted and range of spectrum covered. S.T.Henders

535.3

4985. SINGLETS IN THE Mn II SPECTRUM. L.Iglesias.
J. Opt. Soc. Amer., Vol. 46, No. 6, 449-52 (June, 1956).

With the exception of one $^1S$ term, the whole number of singlet terms which theory predicts for Mn II in the $3d^6$, $3d$ and $3d^5 4p$ configurations, have been discovered; they give 4 atomic energy levels: 16 even and 25 odd. It has been possible to classify a total of 167 lines, 113 being combinations among these singlet terms, and 54 intercombination lines wi quintet and triplet terms, already known.

535.33

4986. HOPFIELD'S EMISSION BANDS OF $O_2$ IN THE REGION 1900-2350 A. Y.Tanaka, A.S.Jursa and F.J.LeBlan
J. chem. Phys., Vol. 24, No. 4, 915-16 (April, 1956).

A discussion of certain u.v. band systems excited by cor densed discharges in $O_2$ (or He-$O_2$). A comparison with Hopfield's data (1930) is made and several additional bands are described. There is a brief discussion of possible mode of excitation. J.D.Cragg

535.33

4987. THE STARK EFFECT IN HYDROGEN AT LOW FIE STRENGTHS. H.Rother.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 185-98 (1956). In

erman.

Describes an experimental method for the measurement of Stark patterns in hydrogen at field strengths ~1.3-2 kV/cm. The electrode system, for giving the Stark field, is carefully analysed and the field distribution is studied in detail. Results are given, with some reference to earlier work. J.D.Craggs

535.337 : 537.228.5

4988. THEORY OF THE STARK EFFECT IN A NONUNIFORM FIELD. III. CALCULATION OF THE PERTURBATION AS A FUNCTION OF THE QUANTUM NUMBERS L, S, J AND $M_J$. R.Cayrel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1265-7 (March 5, 1956). In French.

For Part II, see Abstr. 3573 (1955). An extension of the previous calculations (Abstr. 2576/1955), the perturbation being obtained for each level of the configuration. A table is given of the numerical values. J.Hughes

535.337 : 535.342

4989. THE PERTURBATIONS OF SPECTRAL LINES IN ATOMIC SPECTRA BY THE PRESSURE OF ELECTRICALLY NEUTRAL PARTICLES. St. Robin and S.Robin.
J. Phys. Radium, Vol. 17, No. 2, 143-60 (Feb., 1956). In French.

After a brief description of the experimental methods available, a survey of the experimental results of the perturbation of absorption lines (mainly resonance lines of mercury and the alkali metals and doublets of the principal series of the alkali metals) by various gases, at both high and low pressures, is given. A brief review of the theoretical treatments of these phenomena is given, the interrelation of the various theories, and their success in interpreting the experimental results. The perturbation of emission lines and band spectra induced by pressure are touched on briefly. An extensive bibliography is given. J.Hughes

535.338.33

4990. PROPOSED COINCIDENCE SCHEME FOR THE ELIMINATION OF THE DOPPLER EFFECT. P.L.Sagalyn.
Phys. Rev., Vol. 102, No. 1, 293-4 (April 1, 1956).

If an atom emits two photons in cascade on passage through an intermediate level, the Doppler shifts will be the same. If two photocells are used to scan the respective lines then coincidences will occur at corresponding positions of the Doppler pattern. It is suggested that this principle can be used to determine a wavelength to 1/10 of the Doppler width.
G.F.Lothian

535.338.33

4991. HYPERFINE STRUCTURE BY COINCIDENCE TECHNIQUES. L.C.Bradley, III.
Phys. Rev., Vol. 102, No. 1, 293 (April 1, 1956).

Using an arrangement similar to that described in the preceding abstract, but with the source in a magnetic field and with a radio frequency field giving at resonance a transition between the sublevels of the intermediate level, coincidences will indicate when resonance is attained. The method is being tried on some levels of Ba II. G.F.Lothian

535.338.4

4992. FLAME SPECTRUM OF BARIUM: RED AND INFRARED BANDS. E.M.Bulewicz.
Nature (London), Vol. 177, 670-1 (April 7, 1956).

Flame spectra of the alkaline earths show bands due to XOH (X = Ba, Sr or Ca) and these bands are compared with the emission given by alkaline earth halides. Similarities found in these two cases are discussed. J.D.Craggs

535.343 : 539.132

4993. ABSORPTION SPECTRA AND IONIZATION POTENTIALS OF BENZENE AND BENZENE-$d_6$. P.G.Wilkinson.
J. chem. Phys., Vol. 24, No. 4, 917 (April, 1956).

Four Rydberg series were observed photographically in the vacuum ultraviolet with a Xe source. All converge to a common ionization potential of 9.237 eV for $C_6H_6$ and 9.251 eV for $C_6D_6$. The vibrational structure of the bands is discussed.
G.F.Lothian

535.343 : 539.213

CONTRIBUTION TO THE KNOWLEDGE OF VITREOUS SILICA. See Abstr. 4680

535.343

4994. STUDY OF THE ABSORPTION AND REFLECTION SPECTRA OF THIN FILMS OF SOME SEMICONDUCTORS, IN THE VISIBLE AND NEAR ULTRAVIOLET, AT LIQUID NITROGEN TEMPERATURE. S.Nikitine and R.Reiss.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 1003-5 (Feb. 20, 1956). In French.

Absorption spectra, at 77° K, have been observed in the wavelength range 3000-4500 A for the chlorides, iodides and bromides of copper and thallium. Samples were prepared by sublimation in vacuo on to glass or quartz slides. The various absorption lines (widths 5-30 A) are mainly attributed to exciton formation. The reflection spectra of CuBr and CuCl show "residual rays" at the same wavelengths as the corresponding absorption lines, as well as regions of low reflectivity at shorter wavelengths. D.G.Avery

535.343

4995. ACTION OF WATER VAPOUR ON THE ABSORPTION SPECTRUM OF COPPER CHLORIDE CONTAINING AN EXCESS OF COPPER. P.N.Kokhanenko.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 30-2 (1956). In Russian.

Water vapour leads to the following effects in copper chloride films sublimed in vacuum: disappearance of colour of the film, substitution of the sharp absorption maxima of the excess copper at 3725 and 3780 A by a broad maximum at 3900 A, and finally appearance of a new maximum at 2800 A which disappears with time. It is shown that absorption of the excess copper particles in the surface layers differs from that of the copper particles in the inner layers of the crystal. A.

535.34.07

4996. SPECIAL-PURPOSE INFRARED CELLS.
R.A.Friedel and M.G.Pelipetz.
J. Opt. Soc. Amer., Vol. 45, No. 10, 892 (Oct., 1955).

It is pointed out that a "new infrared microcell" described by W.H.T.Davison (Abstr. 4508/1955) is similar to a cell described earlier by the present authors (Abstr. 260/1954).
G.F.Lothian

535.343

4997. STUDY OF THE AMMONIA BAND AT 4 $\mu$.
C.Haeusler.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1153-4 (Feb. 27, 1956). In French.

The intensity of the band should be increased at high temperature, if it is a difference band. The results at 250° C suggest it is due to several combinations: $\nu_2 + \nu_4$, $\nu_1 - \nu_2$, $\nu_3 - \nu_2$ and $\nu_4 + 2\nu_2 - \nu_2$ G.F.Lothian

535.343

4998. INFRARED SPECTRA OF $T_2O$, THO, AND TDO.
P.A.Staats, H.W.Morgan and J.H.Goldstein.
J. chem. Phys., Vol. 24, No. 4, 916-17 (April, 1956).

Observed vibrational frequencies of the vapours are tabulated and compared with values calculated by Libby (J. chem. Phys., Vol. 11, 101-9, March, 1943). G.F.Lothian

535.343

4999. INFRARED SPECTRUM OF $PF_5$. J.P.Pemsler and W.G.Planet, Jr.
J. chem. Phys., Vol. 24, No. 4, 920-1 (April, 1956).

Wavenumbers (486-2041 $cm^{-1}$) and relative intensities are tabulated. G.F.Lothian

535.343

5000. INFRARED ABSORPTION SPECTRA OF BIFLUORIDES IN ALKALI HALIDE DISKS: THE FORMATION OF MIXED CRYSTALS. J.A.A.Ketelaar, C.Haas and J.van der Elsken.
J. chem. Phys., Vol. 24, No. 3, 624-5 (March, 1956).

A comparison with the corresponding Nujol mulls is made. From the large change in the stretching vibration of $HF_2^-$ in different media it is concluded that formation of mixed crystals takes place. J.Jacobs

535.343

5001. l-TYPE DOUBLING SPECTRA OF HCN AND DCN IN THE S.H.F. REGION. A.Miyahara, H.Hirakawa and K.Shimoda.
J. Phys. Soc. Japan, Vol. 11, No. 3, 335 (March, 1956).

The l-type doubling constants obtained from the observation of microwave transitions between the doublet levels are $q = 224.478 - 0.002667\ J(J+1)$ for HCN and $q = 186.193 - 0.002197\ J(J+1)$ Mc/s for DCN. D.H.Whiffen

535.343

5002. MICROWAVE SPECTRA OF FORMALDEHYDE AND METHYLAMINE IN THE S.H.F. REGION. H.Hirakawa, A.Miyahara and K.Shimoda.
J. Phys. Soc. Japan, Vol. 11, No. 3, 334-5 (March, 1956).

535.345

5003. A SIMPLE SHORT-PATH ABSORPTION CELL. B.F.Hochheimer and G.E.Moore.
J. Opt. Soc. Amer., Vol. 45, No. 10, 891 (Oct., 1955).

Infrared transmitting windows are waxed into a glass tube with a spacer of about 1 mm. G.F.Lothian

535.345 : 535.39 : 539.234

5004. DETERMINATION OF THE REFLECTIVITY, TRANSMISSIVITY, AND ABSORPTIVITY OF THIN SILVER FILMS EVAPORATED ON QUARTZ. J.Trompette.
J. Phys. Radium, Vol. 17, No. 2, 124-8 (Feb., 1956). In French.

A method is described with which the above constants were measured for films of thickness $0 < t < 73$ m$\mu$ with radiations of wavelengths $300 < \lambda < 600$ m$\mu$. The equation absorptivity (air face) x $n_{quartz}$ = absorptivity (quartz face) is valid rigidly for all $\lambda$'s when t = 7.2 m$\mu$, but only for $\lambda > 510$ m$\mu$ when t = 72.2 m$\mu$. 1 table, 10 figs. R.A.Weale

535.37 : 537.311.33

5005. LUMINESCENCE, TRANSMISSION AND WIDTH OF THE ENERGY GAP OF CdTe SINGLE CRYSTALS.
C.Z. van Doorn and D.de Nobel.
Physica, Vol. 22, No. 4, 338-42 (April, 1956).

Irradiation of a CdTe single crystal or biasing a CdTe-p-n junction in the forward direction lead to a luminescence with a maximum at about 8880 A. From transmission measurements and measurements of the long wave limit of the photo e.m.f. of a CdTe-p-n junction as a function of the temperature, the shift of the band edge was seen to vary from $2.34 \times 10^{-4}$ eV/deg K at 77° K to $5.44 \times 10^{-4}$ eV/deg K at 800° K. A.

535.37

5006. THE PROBLEM OF THE POSITION OF THE COPPER ACTIVATOR IN ZINC-SULPHIDE SCINTILLATORS.
A.A.Cherepnev.
Zh. éksper. teor. Fiz., Vol. 28, No. 4, 458-62 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 2, 300-4 (Sept., 1955).

Basic constituents of the phosphor are heated to various temperatures below 600°C and their characteristics measured. The activator is also introduced by thermal diffusion into previously crystallized sulphide. It is concluded that atomic dispersion of copper is essential for luminescence.
G.F.J.Garlick

535.37

5007. THE PROBLEM OF THE EFFECT OF CONCENTRATION ON THE LUMINESCENCE OF SOLUTIONS. M.D.Galanin
Zh. éksper. teor. Fiz., Vol. 28, No. 4, 485-95 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 2, 317-25 (Sept., 1955).

Methods of measurement of the polarization, luminescenc yield, absorption, excitation and emission spectra and decay time of dye molecules in solution are improved, e.g. by using thin layers of solution. The results show good correlation with those of resonance transfer theories. G.F.J.Garlick

535.371 ; 537.57

5008. ON THE INTERPRETATION OF THE IONIZATION AND THE LUMINESCENCE PRODUCED BY HYDRATION OF THE ORGANIC SALTS OF QUININE AND QUINIDINE.
D.M.Kiritch.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1287-9 (March 5, 1956). In French.

Heated crystals show ionization and luminescence effects. Scintillations visible to the naked eye or in some cases seen b use of a lens are observed. Qualitative correlation between ionization and luminescence is found. G.F.J.Garlick

535.371

5009. LUMINESCENCE OF NAPHTHALENE CRYSTALS AT LOW TEMPERATURES IN THE REGION OF 20° K.
P.Pesteil and A.Zmerli.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1876-8 (April, 9 1956). In French.

Experimental studies of naphthalene and seven of its methyl derivatives are described. It is shown that the phosphorescence of naphthalene compounds in the green spectral region corresponds to an excited state of symmetry $^3B_{2u}$, and is related to the near ultraviolet spectrum of the naphthalene fluorescence. Vibrational perturbations at the centre, with symmetry $\beta_{1g}$, are important and give the transition the apparent symmetry $^3B_{3u}$. G.F.J.Garlick

535.371

5010. INFLUENCE OF TEMPERATURE ON THE LUMINESCENCE OF CALCIUM META-ANTIMONATE. R.Bernard and N.Thomas.
J. Phys. Radium, Vol. 16, No. 12, 131S (Dec., 1955). In French.

535.371

5011. PHOSPHORESCENCE OF SODIUM- AND POTASSIUM-ACETATES. K.Osada.
J. Phys. Soc. Japan, Vol. 11, No. 4, 425-9 (April, 1956).

Sodium and potassium acetates emite green light for a few seconds, after being excited in vacuo at 254m$\mu$. Their spectra are composed of a green band with a maximum at 530m$\mu$ and a blue one at 465m$\mu$. The phosphorescence is quenched by oxygen adsorbed in molecular state, and the initial intensity is inversely proportional to the pressure of oxygen, but water vapour and hydrogen have no effect. The intensity is also changed by the treatment of the crystal. The activation energy calculated from the temperature dependence of the lifetime is 0.034 eV. Their ultraviolet absorption spectra are also measured in aqueous or acetic acid solution to 220m$\mu$ with a quartz spectrophotometer. From these results, it may be considered that the phosphorescence is due to crystal imperfections.
A.

535.371

5012. SCINTILLATION DECAY TIMES OF ORGANIC CRYSTALS. G.T.Wright.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 358-72 (March 1, 1956).

A new experimental technique is described for measuring scintillation decay times in the millimicrosecond region. The method developed uses the fact that a pulsed current, as delivered by the photomultiplier scintillation counter, produces

ar greater power dissipation in a resistive load than does same mean steady current. By measuring the power dissated the pulse duration, and hence the scintillation decay me, may be found. A particular advantage of this method that stochastic fluctuations of events in the scintillation nter may be neglected. These fluctuations given the multier output pulse a very irregular profile and are analysed detail using statistical generating functions. The shapes d durations of scintillations excited in anthracene, translbene and para-terphenyl crystals are investigated. For thracene the scintillation pulses delivered at the multiplier de are exponential with decay times of 31 mμsec and mμsec for electron and alpha-particle excitation respecely. The shapes of these pulses are corrected for the ects of transit time spread in the multiplier and for the ect of self-absorption of fluorescence in the crystal to termine the true shape of the molecular scintillation. For th electron and alpha-particle excitation this consists of a ort initial spike of fluorescence followed by a long decay, n-exponential, component; the major part of the emission is ntained in the long decay component. A qualitative analysis the measurements for trans-stilbene and para-terphenyl ows that the scintillations from these crystals are also of is general form. These results are interpreted in terms of e description proposed previously by the author for the scinlation process in organic crystals. This description prects this shape for the molecular scintillation and is therere supported by the present measurements. A.

535.371 : 548.7

013. LUMINESCENCE AND ELECTRICAL CONDUCTIVITY SSOCIATED WITH DEFECTS IN ALKALI HALIDE CRYSTALS. Ewles and J.C.Stead.
oc. Phys. Soc. B, Vol. 69, Pt 3, 396-402 (March 1, 1956).

The emission and excitation spectra of the luminescence oduced in potassium and sodium chlorides by thermal shock, echanical strain or by the introduction of the divalent ions , Sr or Ca show similarities in the same host crystal which e explicable on the assumption that the positive ion vacancies mprise or are part of the luminescent centre. Differences the emission spectra in the same host crystal activated in ese various ways are attributed to differences of association the vacancies. The electrical conductivity of pure annealed aterial as determined by an a.c. method is increased by ermal shock or mechanical strain. The similarity of the adients of the graphs showing log conductivity plotted against ciprocal temperature of the thermally or mechanically rained samples with those of the annealed samples containing dded divalent ions shows that the increased conductivity is due positive ion vacancies; the magnitude of the increase as mpared with the pure annealed crystals indicates that the mber of "free" vacancies is increased some four or five nes by the thermal shock. A.

535.371 : 537.312.5

014. ON A CERTAIN THEORETICAL PROPERTY OF UMINESCENCE AND PHOTOCONDUCTIVITY RELAXATION URVES. N.A.Tolstoĭ and A.V.Shatilov.
h. éksper. teor. Fiz., Vol. 30, No. 1, 109-14 (1956). In ussian.

The generally accepted concept concerning the recombinaon mechanism of phosphors and photoconductors cannot be pplied to describe the kinetics of concentration- or temperare-quenced phosphorescence and photoconductivity, although priori the applicability of these concepts appears to be the ost natural as far as quenching effects are concerned. A.

535.371

015. ON THE POSSIBILITY OF A TWO-STEP MECHANSM OF EXITATION IN SULPHIDE PHOSPHORS. N.A.Tolstoĭ.
h. éksper. teor. Fiz., Vol. 30, No. 1, 171-9 (1956). In ussian.

The experimental data on kinetics of luminescence of trongly-quenched phosphors show that, opposite to the widely spread opinion, the bimolecular theory does not give a correct explanation. An interpretation of experiments is given, based on the mechanism of a two-step excitation of luminescence. It is shown that the photo-conductivity of CdS highly activated with copper is excited by a "two step" process. At the same time the luminescence of this substance shows regularities typical of the case of strong quenching. A.

535.371.07 : 537.531 : 778.333

5016. THE SPECTRAL QUANTUM- AND ENERGY-EFFICIENCY OF CALCIUM TUNGSTATE X-RAY INTENSIFYING SCREENS. R.H.Herz.
Brit. J. appl. Phys., Vol. 7, No. 5, 182-5 (May, 1956).

The intensifying action of calcium tungstate screens in combination with X-ray film has been investigated over a wide range of X-ray wavelengths equivalent to X-rays generated with energies of between 40-1200 kV. By means of the evaluation of the quantum- and energy-efficiencies of screen and film an understanding of their behaviour, i.e. their utilization of energy within this range of quantum energies, is obtained. A.

535.372

5017. LUMINESCENCE SPECTRA OF SAMARIUM IN BARIUM TITANATE AT ITS TRANSITION. K.Oshima, S.Hayakawa, H.Nagano and M.Nagusa.
J. chem. Phys., Vol. 24, No. 4, 903-4 (April, 1956).

The spectrum of samarium (4f shell transitions) in barium titanate shows a doublet structure at temperatures above −80°C (orthorhombic crystal form) but singlet structure below this temperature (rhombohedral crystal form). The change is assumed to arise from change in symmetry and thus to change in the nature of Stark field splitting of the samarium levels. G.F.J.Garlick

535.373

5018. THE DECAY LAWS OF THE AFTERGLOW OF ZINC SULPHIDE PHOSPHORS IN THE TEMPERATURE EXTINCTION REGION. F.I.Vergunas and N.L.Gasting.
Zh. éksper. teor. Fiz., Vol. 28, No. 3, 352-60 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 2, 284-90 (Sept., 1955).

At temperatures where thermal quenching occurs the power law decay of ZnS phosphors alters and as temperature is increased the decay becomes exponential, the exponent being exponentially dependent on temperature. Activation energies from decay time and other measurements e.g. variation of light sum with temperature show mutual agreement. G.F.J.Garlick

535.375.55

5019. ACTION OF WATER ON THE RAMAN FREQUENCIES OF DIOXAN. C.Fauconnier and M.Harrand.
Ann. Phys. (Paris) (Ser. 13), Vol. 1, 5-9 (Jan.-Feb., 1956). In French.

The displacement of the Raman frequencies of dioxan on mixture with water has been studied as a function of concentration. No displacement is observed when dioxan is mixed with non-polar solvents. The vibrations active in the Raman spectrum are figuratively represented. G.I.W.Llewelyn

535.375.56

5020. HIGH RESOLUTION RAMAN SPECTROSCOPY OF GASES. VI. ROTATIONAL SPECTRUM OF SYMMETRIC BENZENE-$d_3$. A.Langseth and B.P.Stoicheff.
Canad. J. Phys., Vol. 34, No. 4, 350-3 (April, 1956).

For Pt V, see Abstr. 1998 (1956). The pure rotational Raman spectrum of $C_6H_3D_3$ vapour at a pressure of 15 cm Hg was photographed in the second order of a 21 ft grating. The value of the rotational constant was found to be $B_0 = 0.1716_5 \pm 0.0001$ cm$^{-1}$. This result confirms the earlier spectroscopic values of the internuclear distances in the benzene molecule. A.

535.376

5021. ON THE EFFECT OF VARIOUS METAL ELECTRODES ON BRIGHTNESS WAVES IN ELECTROLUMINESCENCE. G.Destriau.
Illum. Engng, Vol. 51, No. 2, 197-202 (Feb., 1956).

The wave-form of the brightness of an electroluminescent panel source run on a.c. is affected (aside from the effects of frequency and voltage) by (a) the ratio of the thickness of phosphor to that of insulator, (b) the absolute thickness of the phosphor layer and (c) the nature of the metal backing. The author describes the results of a series of experiments on these effects. Effect (a) is a phase shift which increases with the thickness of the panel; effect (b) is an enhancement of the difference between the wave-forms of the two brightness waves in each voltage cycle; effect (c) is a change of phase angle, of wave-form and of difference between the two wave-forms in a cycle. These changes are related to the work function of the metal which forms the backing. J.W.T.Walsh

535.376

5022. ON THE ELECTROLUMINESCENCE IN ZnS PHOSPHOR. M.Kimata and T.Nomura.
J. Phys. Soc. Japan, Vol. 11, No. 4, 466-7 (April, 1956).

535.376

5023. ELECTROLUMINESCENCE FROM BORON NITRIDE. S.Larach and R.E.Shrader.
Phys. Rev., Vol. 102, No. 2, 582 (April 15, 1956).

The powder is made into the usual type of cell, but with mica separating the BN from the outer electrode. An a.c. field produces electroluminescence of which an uncorrected spectral emission curve is given, extending from 3000 A to beyond 6000 A. S.T.Henderson

535.39 : 538.566 : 534.24

FOURIER TRANSFORM TREATMENT OF THE PROBLEM OF THE REFLECTION OF RADIATION FROM IRREGULAR SURFACES. See Abstr. 4271

535.394

5024. ON SOME ANOMALIES OBSERVED WHEN TOTAL REFLECTION TAKES PLACE AT A THIN TRANSPARENT FILM. P.Bousquet.
J. Phys. Radium, Vol. 16, No. 12, 105S-106S (Dec., 1955). In French.

When light is totally reflected on the hypotenuse of a right-angled prism, the hypotenuse being covered with a thin film of calcium fluoride (up to 10 wavelengths thick) an anomaly occurs at the total reflection boundary. The dark region exhibits a number of sharp fringes which are clearly multiple-beam fringes. In a corresponding manner, when light is transmitted through the thin film in regions which are the total reflection regions, where there should be no light, bright fringes are seen. It is shown that these fringes must have their origin in scattered light and are clear evidence for the existence of either a heterogeneity or an anisotropy in the film. This diffused light shows that the film is not to be considered as continuous. S.Tolansky

535.41 : 535.51

5025. OPTICAL PROPERTIES OF THE DISTRIBUTION OF LIGHT PRODUCED BY INTERFERENCE POLARIZERS. H.Schröder.
Optik, Vol. 13, No. 4, 158-68 (1956). In German.

A study is made of the properties shown by multiple interference films with reference to polarization effects. Such effects can be secured by employing illumination at the Brewster angle; the polarization properties of the multilayers, as they depend upon wavelength and direction of irradiation, is discussed. Possible experimental arrangements are reviewed. By combining two polarizers it is possible to secure distribution of polarized light without loss and to recombine the light in order to produce variable intensity, variable polarization or depolarization, or indeed to produce relative phase differen for interferometric purposes. The effect of the coherence o the light is discussed. S.Tolans

535.41 : 535.51 : 535.24 : 535.

5026. THE APPLICATION OF INTERFERENCE POLARIZERS IN PHOTOMETRY AND COLORIMETRY. H.Schröde
Optik, Vol. 13, No. 4, 169-74 (1956). In German.

It is possible to secure with the aid of a pair of interfer ence polarizers the same type of partial separation and recombination of beams usually obtainable with doubly refracting crystals, but very wide separation of the beams is also obtainable. It follows that the Hardy double-beam method ca be used for photometry and colorimetry in a manner simple than that normally employed. By means of using a rotating analyser flicker methods are secured. The technique is des cribed whereby the method can be used over a wide spectral range. The advantages of the procedure are discussed in detail. S.Tolansk

535.412 : 535.41

5027. THE INTERFERENCE SYSTEMS OF CROSSED DIFFRACTION GRATINGS. J.Guild.
London: Oxford University Press (1956) 160 pp., 7 plates, 5 text-figures.

In this book the author gives the theory of the interference phenomena responsible for the production of moire fringes. The aim of the book is to provide the theoretical ba ground required by those concerned with the practical applic tion of moire fringes to linear measurement and the automation of machine tools, but it should also be of interest to students of optics because of the interesting problems of inte ference which are involved.

535.417 : 531.7

5028. EXCITATION OF MERCURY-198 IN A LIQUID NITROGEN COOLED HOLLOW CATHODE LAMP. K.M.Baird and K.H.Hart.
J. Opt. Soc. Amer., Vol. 46, No. 4, 304-5 (April, 1956).

Reduction in Doppler broadening is investigated qualitatively by comparative tests using a Michelson interferomete Fringes may be observed for path differences of up to 65 cm. G.F.Lothi

535.417 : 535.822.

5029. FRINGE SPACING IN INTERFERENCE MICROSCOPES. F.R.Tolmon and J.G.Wood.
J. sci. Instrum., Vol. 33, No. 6, 236-8 (June, 1956).

In interferometers employing fringes of constant thickne where the incidence is normal or very nearly so, the fringe spacing obtained is accepted as equivalent to half the wavele th of the monochromatic light employed. However, in the case of interference microscopes, with high-powered objective lenses producing strongly convergent incident light, experiments show that the equivalent value of the fringe spac is approximately 10% greater than half the wavelength, a discrepancy undoubtedly due to the obliquity of the rays. The effect is of importance when using interference microscopes for accurately measuring the heights and depths of shallow features on surfaces. A

535.4

5030. PRINCIPLE OF AN ECHELETTE GRATING STIGMATIC FOR TWO WAVELENGTHS. J.Moret-Bailly.
C.R. Acad. Sci. (Paris), Vol. 242, No. 14, 1789-90 (April 4, 1956). In French.

A brief description of a method of making the grating by photographing a fringe system. R.W.Fl

535.43 : 548.

5031. THE SCATTERING OF LIGHT BY SINGLE CRYSTAL
S.P.F.Humphreys-Owen.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 350-7 (March 1, 1956).

The intensity of light scattered at 90° to the incident beam s been investigated as a function of wavelength for a speci- n of colourless, apparently perfect, quartz. The wavelength ction indicates that, in addition to the light scattered by rmal fluctuations of density, to be expected in any crystal, wever perfect, there is a contribution from some real- ucture possessing a linear dimension of about 3000 A. Pre- us work by the author pointed to a similar effect in NaCl stals (Abstr. 6055/1955), in which a dimension of about 00 A was derived, and a preliminary interpretation of the ect was offered in terms of a theoretical real-structure first ggested by Born and later discussed by Fürth. It is now nted out that the formula given by Born does lead to a dimen- n for quartz about twice that for NaCl. But since more than e kind of imperfection could produce this "size effect" a dis- ssion is given of imperfections from this point of view. Two ds come into consideration: (i) clusters of the correct size ndomly embedded in the lattice, (ii) a three-dimensional net roughout the lattice, made up of surfaces of disorder enclos- regions, of the correct size, of perfection. It is argued t the former will produce discrete appearances in the beam light, detectable by ultra-microscope, and that an entirely fuse beam of light indicates their absence. This is the case th several crystals which nevertheless exhibit the size effect, d it seems therefore that the latter alternative, the net, has be accepted. This conclusion is discussed with reference to esent knowledge of subgrain structure as well as to the theo- of Born and Fürth. A.

535.435

032. SCATTERING OF LIGHT BY MACROMOLECULAR OLUTIONS. I. THEORETICAL STUDY OF THE EFFECT OF N ORIENTING ELECTRIC FIELD. C.Wippler.
. Chim. phys., Vol. 53, No. 4, 316-17 (April, 1956). In rench.

The intensity distribution function is calculated as a nction of the electric field E and the electric moments nd polarizabilities of the molecules whose refractive index s near that of the surrounding medium; rigid rods and chains nd flexible chains are considered. If $\Delta P_\theta$ is the change of ntensity of scattered light due to E, then for E parallel and erpendicular to the bisector of the angle between the incident nd scattered light, $\Delta_{\parallel}P + 2\Delta_{\perp}P = 0$ for a rigid particle. It s suggested that experimental confirmation of this relation ay be used as a criterion of rigidity. The relation of these henomena to the Kerr effect is discussed. G.F.Lothian

535.435

033. SCATTERING OF LIGHT BY MACROMOLECULAR OLUTIONS. II. EXPERIMENTAL STUDY OF THE EFFECT F AN ELECTRIC FIELD ON RIGID PARTICLES.
.Wippler.
. Chim. phys., Vol. 53, No. 4, 328-46 (April, 1956). In rench.

The angular distribution of scattered light with no field s made with apparatus described previously (Abstr. 10091/ 954). The apparatus for measurement with an electric field E) uses a square cell with electrodes inside giving a 50 c/s eld at 45° to the incident beam; photomultipliers at 90° on ach side of the incident beam give $P_\perp$ and $P_\parallel$ (see Pt. I). leasurements on tobacco mosaic virus give satisfactory values f the polarizability and optical anisotropy; but measurements ith E = 0 give a rod length 1.4 times that measured with an lectron microscope and this needs further investigation. leasurements on the minerals bentonite and hectorite giving af-shaped particles are satisfactory if it is assumed that ey consist of mixtures of two forms with and without a ermanent electric moment. Measurements on two specimens f thermonucleic acid show that one is unaffected by the field. ll the specimens confirm the condition for rigidity.
G.F.Lothian

535.435

5034. SCATTERING OF LIGHT BY MACROMOLECULAR SOLUTIONS. III. EXPERIMENTAL STUDY OF AN ELECTRIC FIELD ON CHAIN MOLECULES. C.Wippler.
J. Chim. phys., Vol. 53, No. 4, 346-51 (April, 1956). In French.

Measurements on d-l- phenylalanine show that the molecules are flexible chains and give values of molecular weight chain length and electric moment per unit length. Measurements on two specimens of nitrocellulose indicate that they are respectively flexible and rigid but the results are regarded as inconclusive. Measurements on polystyrene and polymethylmethacrylate show no effect because they have no permanent electric moment along the axes of the chain elements; this difficulty would not occur in the use of a hydrodynamic instead of an electric field. G.F.Lothian

535.514 : 535.345

5035. MEASURING SPECTRAL PROPERTIES OF HIGH-EXTINCTION POLARIZERS. L.Baxter II, A.S.Makas and W.A.Shurcliff.
J. Opt. Soc. Amer., Vol. 46, No. 3, 229 (March, 1956).

The difficulties in measurement are, (1) the trouble experienced in making accurate measurements of spectral density in the range 4 to 7 density units, (2) the obtaining of a visual range spectrophotometer to operate at short (375 m$\mu$) and long (750 m$\mu$) wavelengths, (3) the trouble caused by the inherent polarisizing tendencies of the spectrophotometer itself. Details are given describing how these difficulties are surmounted, the first and second by using a Cary spectrophotometer with a neutral filter of density 3, and the third by rotating the sample in its own plane at 6 r.p.s. Some results are shown graphically. H.G.Jerrard

535.514

5036. ON A SODIUM NITRATE POLARIZATION PLATE OF SCATTERING TYPE. T.Yamaguti.
J. Opt. Soc. Amer., Vol. 45, No. 10, 891-2 (Oct., 1955).

A single crystal grown between plates of glass, whose inner faces are ground and whose refractive index (1.59) nearly equals that of the ordinary ray in the crystal, transmits the ordinary ray freely and scatters the extraordinary ray.
G.F.Lothian

535.514.2

5037. THEORY OF ELLIPTIC POLARIZATION OF LIGHT REFLECTED FROM ISOTROPIC MEDIA. D.V.Sivukhin.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 374-81 (1956). In Russian.

Formulae for the amplitudes of reflected light are obtained by considering the interference of the waves radiated by the molecules and atoms of the medium and by taking into account the effect due to the transition layers. No special assumptions are made concerning the molecular structure of the medium or transition layer. The formulae are valid for arbitrarily thin layers including monomolecular layers. The formulae are supplemented by second-order terms with respect to $f\gamma_m$. The mathematical difficulties are circumvented by reducing the radiation from volume sources to that of surface sources. A.

535.515

5038. BIREFRINGENCE RESULTING FROM THE APPLICATION OF AN INTENSE BEAM OF LIGHT TO AN ISOTROPIC MEDIUM. A.D.Buckingham.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 344-9 (March 1, 1956).

The interaction between a rapidly oscillating electric field, such as is found associated with a light wave, and anisotropic molecules is discussed, and it is shown that there will be a tendency for the molecules to be oriented. An isotropic medium will therefore become doubly refracting, the optic axis being parallel to the electric vector of the oscillating field, or

in the case of normal light to its direction of propagation. For the birefringence to be easily measurable a very intense beam of light would be necessary, and a flash apparatus would probably be the most suitable source. A.

535.6

5039. THE BASIC DATA OF COLOUR-MATCHING. W.S.Stiles.
London: The Physical Society Yearbook (1955) 44-65.

The 18th Thomas Young Oration of the Physical Society. A new determination of the colour-matching functions — the quantities of three primary stimuli in a mixture which matches unit energy intensity of the various spectral colours — is described. The reasons for making new measurements, the apparatus and technique being used and the trend of the results obtained so far are discussed. The mean unit colour coordinates and the mean colour-matching functions for the initial group of ten subjects and for both $2^0$ and $10^0$ fields are shown graphically. Comparison of the $2^0$ results with the present standard values (C.I.E. values) which also refer to a small field show minor differences in the unit coordinates in the blue and violet and appreciable differences in the colour-matching functions again mainly at shorter wavelengths. The main difference between the results for the $2^0$ and $10^0$ fields corresponds to a smaller absorption by macular pigment for the larger field. The relative luminous efficiency function derived as a linear combination of the colour-matching functions is also considered. A.

535.653

5040. SPECIFICATIONS AND CALIBRATION OF THE 1953 EDITION OF THE INTER-SOCIETY COLOR COUNCIL COLOR APTITUDE TEST. F.L.Dimmick.
J. Opt. Soc. Amer., Vol. 46, No. 6, 389-93 (June, 1956).

The 'Color Aptitude Test' is now a well-developed, colour-matching test consisting of saturation series of carefully prepared chips in four colours. Colorimetric and spectrophotometric specifications have been presented. Analysis of some 1000 testings indicates (1) a satisfactory regularity of spacing of the chips, (2) a near normal distribution of total scores derived from weighted scores per 'match', (3) good test-retest reliability consistent with high sensitivity of a discrimination, and (4) a measure of reliability of individual performances in terms of test to retest change in score. A.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.826 : 539.215.08

5041. THE PRODUCTION OF TRANSPARENT PROFILES OF DUST PARTICLES AS AN AID TO AUTOMATIZED PARTICLE COUNTING. R.J.Hamilton and B.A.Phelps.
Brit. J. appl. Phys., Vol. 7, No. 5, 186-8 (May, 1956).

The technique of "shadowing" by metal evaporation in a vacuum has been adapted to the production of plane "negative" images of dust deposits on microscope slides at natural size by vacuum evaporation of metal at right angles to the slide, and subsequent removal of the dust. The slide receives a precise impression of the geometric projections of the particles. The correspondence of image and object is exact. The thickness of the deposited film can be suited to the contrast requirements of an automatic particle counter; further, the film lies in one plane and is only a few hundred ångström units thick. Many of the optical problems arising from the association of automatic counting techniques with high power light microscopy, namely, depth of focus and variable contrast between particles and background and between different parts of single particles, are avoided by substituting the shadow for the original specimen, as suggested by Whitaker. A.



536.2

5042. GRAPHICAL SOLUTION OF LINEAR HEAT FLOW WITH RADIATION. M.Nagai.
J. Phys. Soc. Japan, Vol. 11, No. 3, 329-30 (March, 1956).

The differential equation representing the temperature distribution on a uniform wire or plate subject to surface radiation is transformed by appropriate substitutions into $d^2\eta/d\xi^2 = \frac{5}{2}(\eta^4 - 1)$ leading to the solution

$$\xi = \pm\int_{\eta_0}^{\eta} (\eta^5 - 5\eta - \eta_0^5 + 5\eta_0)^{-1/2}\, d\eta.$$

A graph of the integral in the practical range of $\xi$ and $\eta$ with $\eta_0$ as parameter is given. S.Weintro

536.413 : 539.21

5043. THERMAL EXPANSION AND STABILITY OF LAYE STRUCTURES IN IONIC AB COMPOUNDS. M.A.Bredig.
J. chem. Phys., Vol. 24, No. 5, 1037-40 (May, 1956).

Thermal expansion in PbO, SnO, or LiOH, in which sing layers of $O^{2-}$ or $Li^+$ alternate with double layers of $Pb^{2+}$, $Sn^{2}$ or $(OH)^-$, respectively, is relatively small normal to the layers(c-axis). This "anomaly" is related to asymmetrical dilatation of the polarizable $Pb^{2+}$, $Sn^{2+}$ in the field of $O^{2-}$ anions, or, respectively, to elongation of $(OH)^-$ in the field of $Li^+$: When the cation—anion distance increases with tem perature, the resulting decrease in these deformations reduces the spacing between the layers of like polarizable ions and the effective thermal expansion. Structures of this type are not stable for AB compounds if the polarized ion i the anion, but are if it is the cation: As cation polarizability increases with polarization, asymmetric, one-sided coordin tion of polarizing anions occurs, the energy being further lowered by dispersion forces acting between dilated cations On the other hand, anions tightened by cations approach the behaviour of rigid ions in coordinating cations more symmetrically in three-, rather than two-dimensional networks

536.421

5044. KINETICS OF SOLIDIFICATION. K.A.Jackson and B.Chalmers.
Canad. J. Phys., Vol. 34, No. 5, 473-90 (May, 1956).

The kinetic theory of melting and freezing is developed from consideration of atom movements at an interface betwe solid and liquid. The equations developed are shown to have the same form as the corresponding thermodynamic equatio The homogeneous nucleation of a solid phase in a liquid in th considered from the point of view of this theory. Agreement with experimental observation is obtained on the following points. (1) The supercooling at which homogeneous nucleati occurs is proportional to the absolute equilibrium temperatu (2) The surface free energy per atom used in the quasi-therm dynamic treatment of nucleation should be equal to one-half the latent heat per atom. (3) The amount of liquid supercool has a very small effect on the temperature at which homoger ous nucleation occurs.

536.423.15 : 533.

5045. THE USE OF DIFFUSION COEFFICIENTS IN THE MEASUREMENT OF VAPOR PRESSURE. W.L.Crider.
J. Amer. Chem. Soc., Vol. 78, No. 5, 924-5 (March 5, 1956)

From the measured rates of evaporation of water vapou from the surface of pure water into pure nitrogen, hydrogen and carbon dioxide, the mutual coefficients of diffusion have been determined at temperatures of 34, 56 and 76°. By usin these values as here determined for the $N_2$-$H_2O$ system and t measured rates of evaporation of water vapour from solution of sucrose and from sodium chloride solutions into nitrogen, a new method was used to measure vapour pressures of thes solutions by making use of the diffusion theory and a transpo form of the diffusion equation. The sucrose solutions ranged

f concentration from 1 to 60% sucrose and the sodium chloride
g ution studies were from 1 to 25% sodium chloride. Vapour
p ssures were determined for each concentration of solution
a 56 and 76°. A.

536.46

546. FLAME ZONE STUDIES. II. APPLICABILITY OF
O E-DIMENSIONAL MODELS TO THREE-DIMENSIONAL
I MINAR BUNSEN FLAME FRONTS. R.M.Fristrom.
J chem. Phys., Vol. 24, No. 4, 888-94 (April, 1956).

For Pt I, see Abstr. 3376 (1954). The applicability of
o -dimensional models in flame theories has been investigated
o erimentally in the case of a lean quarter-atmosphere pro-
p e air flame. Studies of flow patterns through the flame
f nts were made using particle track techniques. From this
p e-position information, normal gas velocity, stream tube
a a, and gas density were calculated throughout the flame
f nt. If the density is a single valued measure of the state of
t gas, then one-dimensional models can be tested for Bunsen
f mes. Unidimensionality was verified for this and several
o er propane-air flames under a number of conditions. In the
f ction region preceding the luminous zone it was also found
t t the velocity and density profiles were invariant with
r pect to changes in flame geometry, gas flow and burner
d meter. Therefore, it is a good approximation to speak of
s gle reaction path for this flame, which is a function only
o the initial state of the gas. The measurements indicate that
o -dimensional flame theories should be modified to include
t effects of area expansion during the course of the reaction.
C ntinuity, diffusion and heat conduction equations should also
b generalized to include the effect of expansion. It was noted
t t the hydrocarbon flame reaction consists of two regions:
a ast propagating reaction associated with the luminous
r gions and the major portion of the heat release and a slow
s condary reaction associated with the post luminous mantel
o the flame. Flow in the primary region is a function only of
t initial state of gas and independent of external influences
s h as gas velocity and flame geometry. Flow in the second-
a y region could be varied over wide limits with no measure-
a e effect on the propagation of the flame. Burning velocity
w s found to be independent of gas velocity, flame geometry,
a l radius of curvature of flame front, and a function only of
t initial state of the gas, providing it was defined as the
m nimum normal gas velocity ahead of the flame front. A dis-
c ssion is given of the errors introduced by measuring burning
v locity by flow measurements in the throat of the burner. A.

536.46 : 537.566

547. PROBE STUDIES OF A RAREFIED FLAME.
V. Tverdokhlebov.
Z. éksper. teor. Fiz., Vol. 30, No. 2, 252-5 (1956). In Russian.

The dependence of the probe current on the position of the probe in a rarefied flame is examined. A hypothesis concerning the ionization mechanism in the reaction zone of the flame is proposed. A.

536.46 : 541.126

PHOTOMETRIC INVESTIGATIONS OF ALKALI METALS
I HYDROGEN FLAME GASES. THE STUDY OF EXCESS
C NCENTRATIONS OF HYDROGEN ATOMS IN BURNT GAS
M XTURES. See Abstr. 4714

536.468 : 533.6.011

548. SPARK IGNITION OF FLOWING GASES. I.Kimura
a d S.Kumagai.
J Phys., Soc. Japan, Vol. 11, No. 5, 599-604 (May, 1956).

Spark ignition of flowing gases is investigated experimentally at room temperature and atmospheric pressure. Under laminar conditions the inflammability of flowing gases increases with gas velocity. This is due to the tendency of initial flames to escape from the quenching effect of electrodes under the influence of gas flow. Under turbulent condition the inflammability of flowing gases decreases with increasing gas velocity. This is ascribed to the increased eddy diffusivity and is in accordance with the result of Swett's experiment under turbulent condition at reduced pressures. A.

536.48

5049. FLOW OF LIQUID HELIUM THROUGH POROUS VYCOR GLASS. K.R.Atkins, H.Seki and E.U.Condon.
Phys. Rev., Vol. 102, No. 2, 582-3 (April 15, 1956).

Liquid helium is filled into vertical glass tubes which are connected with the surrounding liquid through a stretch of porous material with pore diameters of about $5 \times 10^{-7}$ cm. By raising or lowering a tube the liquid is set in motion; the rate of displacement of its level is observed with a cathetometer. It is found that the rate of flow depends critically on the temperature, being negligibly small beyond an "onset temperature" and rising to velocities of more than 1 cm/sec below this temperature. The onset temperature appears to depend upon the size of the pores, decreasing with diminishing diameter; in the present experiments it is found to be lower than the temperature of the λ-transition. Helium films are known to behave in a similar way so that the onset temperature decreases with diminishing thickness. Comparison of pore diameter and film thickness as corresponding to equal onset temperatures shows comparable but not equal values. R.Eisenschitz

536.48

5050. THE PROPAGATION OF HEAT IN LIQUID HELIUM AT TEMPERATURES BELOW 0.6° K. D.V.Osborne.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 301-28 (April, 1956).

Experiments are described in which sine waves of heat are propagated in liquid helium at temperatures between 0.25° K and 0.6° K. Although propagation takes place in a closed tube, resonance does not occur, but, by measuring the phase and amplitude of the temperature waves, values are deduced for the velocity and attenuation of the waves at frequencies between 60 c/s and 2 kc/s. The velocity increases with frequency; at 0.5° K it tends to a limit of about 133 m $sec^{-1}$ at high frequencies, but at 0.25° K it reaches about 190 m $sec^{-1}$ at 2 kc/s and is still increasing. The attenuation per wavelength decreases with increasing frequency being nearly $2\pi$ at the lowest frequencies. At temperatures up to 0.4° K it is shown that the mean free path of the phonons must be greater than the tube diameter (2 cm) and that their reflection at the wall must be partly diffuse. The data are quantitatively explained if about one-third of the phonons suffer diffuse reflection and the remainder suffer specular reflection. Above 0.5° K the mean free path is found to be smaller than the tube diameter, being about 0.08 cm at 0.54° K and about 0.04 cm at 0.58° K. A.

536.521 : 621.317.39

5051. A NEW METHOD FOR THE MEASUREMENT OF RAPID FLUCTUATIONS OF TEMPERATURE. R.Dehn.
Brit. J. appl. Phys., Vol.7, No. 4, 144-8 (April, 1956).

The method described uses a photomultiplier in conjunction with an infrared image converter to measure changes in surface temperature of the cathode of an oscillating magnetron during microsecond pulses. The instantaneous changes in temperature are displayed as pulses on the screen of a c.r.o. The procedure is given of calibrating the apparatus against an optical pyrometer. Changes as small as 2 deg C in 800-900° C have been detected (solid angle equals $2.5 \times 10^{-3}$ steradians). A.

536.531

5052. MEASUREMENT OF SMALL TEMPERATURE DIFFERENCES WITH THE HOT-WIRE BRIDGE. R.Schneider.
Arch. tech. Messen, Issue No. 237 (Ref. V212-3), 217-20 (Oct., 1955). In German.

A mathematical treatment of small variations of temperature and current in the symmetrical hot-wire bridge. It is shown that if in a temperature-unbalanced bridge the indicator

across the diagonal is matched to give max. power in its coil, the deflection is independent of small fluctuations of supply current to the bridge. C.F.Pizzey

536.62

5053. ON THE DYNAMIC TEMPERATURE RESPONSE OF A VACUUM CALORIMETER. J.S.Kouvel.
J. appl. Phys., Vol. 27, No. 6, 639-42 (June, 1956).

A simple graphical method is described for computing the heat capacity of a specimen in a vacuum calorimeter system from the temperature response in the after-heating period. The applicability of this method when there are appreciable time lags due to thermal gradients in the specimen or due to the characteristics of a galvanometer, is discussed. A.

536.621

5054. CALORIMETRY BY THE METHOD OF MIXTURES. D.W.Plester, S.E.Rogers and A.R.Ubbelohde.
J. sci. Instrum., Vol. 33, No. 6, 211-12 (June, 1956).

A vacuum calorimeter is described, suitable for measuring heat contents of condensed phases at high temperatures. The heat of fusion of potassium thiocyanate has been evaluated as $H_f = 3.39 \pm 0.05$ kcal/mol. (mean deviation). A.

536.63

5055. CONSTITUTIVE NATURE OF THE HEAT CAPACITY OF GASES. H.J.Bernstein.
J. chem. Phys., Vol. 24, No. 4, 911 (April, 1956).

Considerations are advanced to show that the vibrational specific heat of a gas may be written in terms of the fundamental frequencies, $\nu$, in the form

$$C_{vib.} = A_0 + A_1\Sigma\nu/T + A_2\Sigma\nu^2/T^2$$

where A's are constants. This is used with the vibrational data to calculate $C_p$ for halogenated methanes and ethylenes; comparison is made with values calculated from an additivity model (Abstr. 3716/1954). The agreement is better than ½%. F.E.Hoare

536.63

5056. POWER SERIES FOR THE TEMPERATURE DEPENDENCE OF THE HEAT CAPACITY OF GASES. H.J.Bernstein.
J. chem. Phys., Vol. 24, No. 4, 911-12 (April, 1956).

The letter reported in the preceding abstract indicates that for a gas $C_p^0 = B_0 + B_1/T + B_2/T^2$. The value of $C_p$ at any pressure may be obtained using Berthelot's equation and the correction so shown to be small. An equation of the given form may be expected to represent the temperature variation of specific heat at any pressure. Comparison of an equation of this type and a quadratic form in T as fitted to the data for $CCl_4$, and the use of similar equations as extrapolation formulae for normal hexane, show the former to be preferable. F.E.Hoare

## THERMODYNAMICS 536.7/.8

536.7

5057. STOCHASTIC BASIS OF ONSAGER'S MINIMUM PRINCIPLE. A.Siegel.
Phys. Rev., Vol. 102, No. 4, 953-9 (May 15, 1956).

The phenomenological equations of motion of thermodynamic quantities, and Onsager's minimum principle, are correct only to the extent that fluctuations are neglected. This paper presents a statistical analysis of the problem and gives a criterion for the validity of the phenomenological approximation. A.

536.71 : 541.126

5058. EQUATION OF STATE FROM THE THEORY OF DETONATION. M.P.Murgai.
J. chem. Phys., Vol. 24, No. 3, 635 (March, 1956).

An extension of Corner's equation of state is derived by application of the theory of detonation, selecting suitable initia conditions. Reasonably good experimental verification is obtained. C.E.King

536.7

5059. IDENTITY OF THE THEOREM OF USABLE ENERGY AND THE THEOREMS OF CARNOT AND CLAUSIUS. R.Marchal.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1699-702 (March 26, 1956). In French.

The three theorems are equally complete mathematical forms of the second law of thermodynamics. That to be used depends on the problem in hand; the principle of usable energy is particularly useful in dealing with machines in contact with the atmosphere such as internal combustion engines. F.E.Hoare

536.75

5060. ON THE DEFINITION OF ENTROPY, IN STATISTICAL MECHANICS, FOR NONEQUILIBRIUM STATES. F.Lurçat.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1686-8 (March 26, 1956). In French.

The expression for the entropy S in nuclear magnetic resonance, proposed by Wangsness (Abstr. 2993/1956) is criticized, and reasons are given for the applicability of $S = -kTr(\rho \log \rho)$; ($\rho$ = density matrix) which leads to the resul that the principle of minimum entropy production is not verified in the present case. F.Ansbacher

## ELECTRICITY 537

537.12

5061. MEASUREMENT OF ELECTRONIC CHARGE-TO-MASS RATIO FOR THE GENERAL PHYSICS LABORATORY. G.Bradley.
Amer. J. Phys., Vol. 24, No. 5, 410-11 (May, 1956).

537.123

5062. A POSSIBLE EXAMPLE OF PRODUCTION AND ANNIHILATION OF AN ANTIPROTON. M.Teucher, H.Winzeler and E.Lohrmann.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 228-30 (Jan., 1956).

In a stack of stripped emulsions flown at 29 km altitude in Texas in January 1955, an event was found consisting of two stars joined by the track of a heavily ionizing particle of mass determined as

$$(1880 \begin{smallmatrix} + 1000 \\ - 650 \end{smallmatrix}) m_e.$$

It is suggested that the event is due to the production and annihilation of an antiproton. The possibility of production of a proton–antiproton pair has been investigated assuming pure multiple production in a nucleon–nucleon, or in a meson–nucleon collision. E.W.Kellermann

## ELECTROSTATICS. DIELECTRICS 537.2

537.2 : 541.126

5063. DEMONSTRATION OF AN EXPLOSION INITIATED BY STATIC ELECTRICITY. D.S.Ainslie.
Amer. J. Phys., Vol. 24, No. 5, 408 (May, 1956).

537.226

)64. DIELECTRIC SATURATION. J.A.Schellman.
chem. Phys., Vol. 24, No. 4, 912-13 (April, 1956).

The dielectric saturation of some highly polar liquids has en measured by means of a pulse technique (Malsch, 1929) which heating by conduction is negligible. The results do t agree with the theoretical predictions of Debye, Van Vleck, d Böttcher. Agreement is improved by taking into account liabatic heating and simple relaxation. It is suggested that further still much needed improvement might be brought out by considering electrostriction. W.Good

537.226 : 621.315.615

)65. SOME HYDRODYNAMICAL PHENOMENA ACCOMANYING THE PASSAGE OF A CURRENT THROUGH INSULAING LIQUIDS. G.A.Ostroumov.
h. éksper. teor. Fiz., Vol. 30, No. 2, 282-6 (1956). In ussian.

Experiments carried out with turpentine, benzene, nitroenzene, benzine (petrol) and transformer oil show that the quids begin to move in a strong almost uniform electric field, ie direction of the applied field being of no consequence. A.

537.226.2

)66. DIELECTRIC ANOMALIES IN AMMONIUM SULHATE. L.Couture, S.Le Montagner, J.Le Bot and .Le Traon.
.R. Acad. Sci. (Paris), Vol. 242, No. 14, 1804-6 (April 4, )56). In French.

Measured along the a axis, the dielectric constant of nmonium sulphate rises suddenly on heating through the ansition point at 224°K at centimetric wavelengths (25 000 Mc/s) it falls equally sharply at kilometric wavelengths (6 Mc/s). is suggested that the Debye temperatures of the high- and w-temperature modifications lie close to, and respectively elow and above the transition temperature. If the transition mperature changes slightly with frequency then the change in e imaginary part of the dielectric constant can be explained. A.L.Mackay

537.226.2

067. THE DEPENDENCE OF COERCIVE FORCE AND ERMITTIVITY OF BARIUM TITANATE CERAMIC UPON ECHANICAL STRESSES. N.A.Roĭ.
kust. Zh., Vol. 1, No. 4, 352-5 (1955). In Russian.

Application of mechanical stress is shown to increase the ercive force of barium tatanate. A study of the variation of electric constant with temperature of the ceramic both in e free and stressed states leads the author to the conclusion at current thermodynamic theory, taking no account of omain structure, does not fit the facts. C.R.S.Manders

537.226.2

068. FERROELECTRICITY IN THE ALUMS. R.Pepinsky, . Jona and G.Shirane.
hys. Rev., Vol. 102, No. 4, 1181-2 (May 15, 1956).

The variation with temp. of the permittivity and dielectric oss of methyl ammonium aluminium alum is typical of ferrolectrics, but the coercive field is unusually large and increases rapidly with decreasing temp. At the Curie point, 66°K the spontaneous polarization is $\sim 0.6\,\mu C/cm^2$. Ferroelectric behaviour occurs in many other alums, but some are ntiferroelectric. J.H.Mason

537.226.2

069. GUANIDINE VANADIUM SULFATE HEXAHYDRATE G.V.S.H.]: A NEW FERROELECTRIC MATERIAL.
.P.Remeika and W.J.Merz.
hys. Rev., Vol. 102, No. 1, 295 (April 1, 1956).

G.V.S.H. has similar physical properties to guanidine luminium sulphate hexahydrate, (G.A.S.H. Abstr. 2065/1956). t ~20°C the spontaneous polarization is $0.38\,\mu C/cm^2$. The ysteresis loop with G.V.S.H. is more rectangular and shows less bias than for G.A.S.H., especially after 60 c/s ageing which permanently improves G.V.S.H. J.H.Mason

537.226.2 : 537.227

5070. SPONTANEOUS POLARIZATION OF GUANIDINE ALUMINUM SULFATE HEXAHYDRATE AT LOW TEMPERATURES. A.G.Chynoweth.
Phys. Rev., Vol. 102, No. 4, 1021-3 (May 15, 1956).

Pyroelectric currents produced by light flashes have been observed and measured in single crystals of guanidine aluminium sulphate hexahydrate from room temperature down to −180°C. At room temperature the currents are about one-tenth of those produced in equivalent barium titanate crystals, the difference being due mainly to the lower value of the pyroelectric coefficient. Since the pyroelectric current is a smooth function of the temperature over the range studied, it is concluded that the spontaneous polarization and the specific heat also are smooth functions of temperature over the same range. There is no evidence of any phase transition or Curie point. At the lowest temperatures the direction of polarization can be reversed by applying a steady field to the crystal. However, the relaxation time for switching is very long compared to its value at room temperature, this being in accord with the known frequency dependence of the coercive force. A.

537.226.2 : 537.228.2 : 539.32

5071. ELECTROMECHANICAL PROPERTIES OF BARIUM TITANATE CERAMICS. G.Mesnard and L.Eyraud.
J. Phys. Radium, Vol. 16, No. 12, 926-38 (Dec., 1955). In French.

High-frequency resonance methods for determining the elastic, electrostrictive and dielectric properties of sintered disks of $BaTiO_3$ are discussed in relation to the theory of electrostriction in ferroelectrics. (See Abstr. 570/1949). An equivalent circuit is used to deduce the Q of the ceramic disks. The effect of varying the temp. between −150 and +150°C, and increasing the applied field up to 20 kV/cm is discussed. Values of the frequencies of resonance and anti-resonance, and of the circuit impedance at these frequencies are discussed. J.H.Mason

537.226.2 : 538.22 : 548.7

5072. THE STUDY ON SUBSTANCES HAVING THE ILMENITE STRUCTURE. I. PHYSICAL PROPERTIES OF SYNTHESIZED $FeTiO_3$ AND $NiTiO_3$ CERAMICS. Y.Ishikawa and S.Sawada.
J. Phys. Soc. Japan, Vol. 11, No. 5, 496-501 (May, 1956).

$FeTiO_3$ and $NiTiO_3$ ceramics were synthesized, their thermal, electrical and magnetic properties were investigated and the results obtained were discussed in connection with the crystal structure. Although $NiTiO_3$ is stable up to high temperatures even in air, $FeTiO_3$ is partially oxidized even when it is cooled, being kept in vacuum ($10^{-5}$ mm Hg), to room temperature from the maturing temperature (1350°C). Electrical and magnetic properties of annealed $FeTiO_3$, therefore, differ greatly from those of $NiTiO_3$, but properties of quenched $FeTiO_3$ tend to those of $NiTiO_3$. From these facts, it is concluded that the properties of $NiTiO_3$ are characteristics of the ilmenite structure. In discussion attention was paid especially to the relation between the ilmenite structure and its magnetic properties and to the mechanism of electrical conduction, and it was speculated, from these considerations, what role $Ti^{4+}$ ions would play in this structure. A.

537.226.3

5073. DEBYE'S DIPOLAR ABSORPTION. R.Freymann.
Cahiers de Phys., No. 67, 19-43 (March, 1956). In French.

A general review with emphasis on solids, crystal defects, adsorption layers etc. 36 refs. D.H.Whiffen

537.226.3 : 548.7

5074. DIELECTRIC LOSSES IN ADDITIVELY COLORED NaCl AND KBr. G.Jacobs.
J. chem. Phys., Vol. 24, No. 3, 629-30 (March, 1956).

Maxima occur in the variation of dielectric loss with applied field frequency the position of the main maximum increasing with temperature. The intensity and position of the dielectric absorption are dependent on the previous history of the crystals. It is not certain whether the absorption is directly due to F-centres or to other complexes in the lattice.

G.F.J.Garlick

537.226.8 : 539.133

5075. DIPOLE MOMENTS AND DIELECTRIC POLARIZATION IN SOLUTIONS. F.E.Harris and S.G.Brush.
J. Amer. Chem. Soc., Vol. 78, No. 7, 1280-7 (April 5, 1956).

The statistical mechanical theory of dielectric polarization is extended to mixtures and applied to dilute solutions of polar molecules in non-polar solvents. The resulting equation, which differs significantly from that of Debye, permits unambiguous experimental determination of a precisely defined effective dipole moment in solution. The relation between the solution moment and vacuum moment is discussed in terms of an ellipsoidal molecule—continuous solvent model, and it is shown that it is necessary to consider the induced polarization of both the polar molecule and surrounding solvent. The solvent effects calculated on the basis of this model differ from earlier results of others based on the same model, and are in qualitative agreement with experiment. Alternative ways of calculating the distortion polarization are discussed and it is concluded that the Clausius—Mossotti expression is, although not ideal, adequate for this purpose. A.

537.226.8

5076. DIELECTRIC BREAKDOWN AND PULSE CONDUCTION OF SILVER HALIDE CRYSTALS. T.Suita and N.Itoh.
J. Phys. Soc. Japan, Vol. 11, No. 5, 474-9 (May, 1956).

Several experiments on the dielectric breakdown of silver halide crystals were made, concerning the influence of illumination and temperature. The temperature dependency of the breakdown strength of silver halide crystals seems to be similar to that of alkali halide crystals. The photographic silver specks in the crystals, which were made by illumination and then by being kept in the dark, are found to raise the breakdown strength. The effect of illumination is dependent on the interval between illumination and breakdown, and on the repetition rate. These effects seem to be explained by photoelectrons, positive holes, ions, and their space charge. Electrical conductivity of pulse electric field was also measured, showing that the ionic current is predominant even in such a short pulse field. A.

537.226.8

5077. DEPENDENCE OF THE DIELECTRIC BREAKDOWN STRENGTH OF SOME ALKALI HALIDE MONOCRYSTALS ON THE DURATION OF APPLICATION OF THE VOLTAGE. G.A.Vorob'ev.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 256-61 (1956). In Russian.

The dependence of the dielectric breakdown strength of NaCl, KBr and KI monocrystals on the duration of application of the voltage was investigated experimentally. The formation time and rate of growth of the discharge in the dielectric was investigated. It is suggested that the ion space charge leads to an increase of the breakdown field strength at short intervals of voltage application of the order of $10^{-8}$ sec. For breakdown due to pulsed voltages the dielectric breakdown strength was found to be proportional to the crystal lattice energy. The experimental data and breakdown oscillograms point to the existence of two breakdown stages in the dielectrics investigated. A.

537.227

5078. SURFACE SPACE-CHARGE LAYERS IN BARIUM TITANATE. A.G.Chynoweth.
Phys. Rev., Vol. 102, No. 3, 705-14 (May 1, 1956).

Above the Curie temperature, pyroelectric currents can be produced in single crystals of barium titanate even though there is no electric field applied. The polarization that remains at these temperatures is ascribed to space-charge fields in the crystal. From studies of the wave forms of the pyroelectric current signals it is concluded, tentatively, that space-charge layers of up to $10^{-5}$ cm in thickness reside at the crystal surface and that these space charges also produce a field through the interior of the crystal. Further evidence for space-charge fields is provided by the occurrence of an associated photovoltaic effect and by asymmetrical hysteresis loops. The space-charge fields vary considerably in magnitud from crystal to crystal. In general, they can be modified by suitable heat treatment but return to their original condition when fields are applied above the Curie point. The space-charge fields apparently influence the direction in which the domains polarize when the crystal is cooled through the Curie point. They will also affect capacity measurements above the transition and will influence the actual temperature of the transition. It is quite possible that the fields play an importan role in the process of domain nucleation. A

537.228.1 : 539.31

5079. SOME APPLICATIONS OF THE LINEAR PIEZOELECTRIC EQUATIONS OF STATE. R.Bechmann.
I.R.E. Trans Ultrasonics Engng, No. PGUE-3, 43-62 (May, 1955).

Convenient tabulation of the piezoelectric equations of sta and the relationship among the various constants are given. The linear piezoelectric equations of state for the general three-dimensional application are simplified to two- and one-dimensional strain and stress systems for application in finite or infinitely extended thin plates and in thin bars. For conven ience, the introduction of some special elastic and piezoelectric constants seems necessary. Systematic notations for these constants are proposed. For the special cases mentione the relationship between the dielectric constants at constant stress and constant strain is considered, followed by the derivation of certain practically important relationships. The electromechanical coupling factor is considered. Expressions are derived for the cases mentioned. The static coupling factor is compared with the dynamic coupling factor of various modes of vibrations of plates and bars. W.Bardsley

537.228.1

5080. EFFECTS OF AMBIENT ATMOSPHERE ON THE STABILITY OF BARIUM TITANATE. J.R.Anderson, G.W.Brady, W.J.Merz and J.P.Remeika.
J. appl. Phys., Vol. 26, No. 11, 1387-8 (Nov., 1955).

Hysteresis loops traced at 50 c/s are nearly rectangular (apart from lead capacitance effects) when the crystal is mounted in dry air; they become markedly rounded on changing the ambient to a vacuum of $10^{-6}$ mm Hg or to 350 mm Hg o $N_2$, but recover their original shape on exposure to 350 mm H or more of $O_2$. The effects require several minutes to develop, and are believed to be related to surface states on the $BaTiO_3$. F.F.Roberts

537.228.2 : 539.32

5081. THE TEMPERATURE VARIATION OF THE ELECTROSTRICTIVE AND ELASTIC PROPERTIES OF BARIUM TITANATE CERAMIC. N.A.Roĭ.
Akust. Zh., Vol. 1, No. 3, 264-71 (1955). In Russian.

An experimental paper describing how, using a pulsed electromechanical probe, the Young's modulus and the electro striction coefficients of barium titanate ceramic have been determined over a range of temperatures 15-150°C. Relations are given between the electrostriction coefficients connecting strain with field, strain with polarization, mechanical stress with field, mechanical stress with polarization, and conclusion arrived at concerning their dependence on temperature.

C.R.S.Manders

## ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1 : 548.7

5082. SOME MODERN ASPECTS OF CRYSTALLINE CONUCTIVITY. B.Claudel.
ull. Soc. Chim. France, 1956, No. 4, 708-31 (April). In rench.

A theoretical review of electronic and ionic conductivity n crystals. The band picture of electrons in solids is developed according to the Bloch treatment and applied to impurity-ctivated and intrinsic semiconductors. The experimental disaction between electronic and ionic conductivity is given. onic conductivity is considered in terms of Frenkel and chottky defects. Examples of both types of conduction are iven together with a review of recent experimental data.
G.F.J.Garlick

537.311.1 : 548.7

5083. RESISTIVITY OF INTERSTITIAL ATOMS AND VACANCIES IN COPPER. A.W.Overhauser and R.L.Gorman.
Phys. Rev., Vol. 102, No. 3, 676-81 (May 1, 1956).

The residual resistivity associated with the presence of interstitial atoms or vacancies in copper is studied with particular attention devoted to the scattering of conduction electrons resulting from lattice distortions surrounding the imperfections. For interstitials this scattering is found to be an order of magnitude larger than that from the defect itself. For vacancies it is smaller but still important. Interference between scattering from the defect and the surrounding lattice distortion is computed and found to be very small. The calculated resistivity associated with one atomic % of interstitial atoms is 10.5 $\mu$ohm. cm. The corresponding value vacancies is 1.5 $\mu$ohm. cm. Using nominal values for the energy of formation of these defects, the stored energy to resistivity ratios associated with interstitials, vacancies, and interstitial-vacancy pairs are 1.4, 3.4, and 1.6 cal/g per $\mu$ ohm cm, respectively. A.

537.311.1 : 539.23

5084. THE ELECTRICAL CONDUCTIVITY OF ANISOTROPIC THIN FILMS. R.Engleman and E.H.Sondheimer.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 449-58 (April, 1956).

It is shown that, when the electron free path is large, the theoretical electrical conductivity of single crystal metal films exhibits anomalous anisotropic properties similar to, but even more pronounced than, those found in the anomalous skin effect in anisotropic metals. It is suggested that experiments on the anisotropic behaviour of thin films may be of value in the study of the electronic configuration of metals. A.

537.311.31

5085. INTEGRALS OF INTEREST IN METALLIC CONDUCTIVITY. D.K.C.MacDonald and L.T.Towle.
Canad. J. Phys., Vol. 34, No. 4, 418-19 (April, 1956).

Tables of

$$J_r(x) = \int_0^x \frac{z^r dz}{(e^z-1)(1-e^{-z})}$$

are given for r = 2, 3, 4, 6, to supplement data previously published by Sondheimer (1950). C.A.Hogarth

537.311.31

5086. THE ELECTRICAL RESISTIVITY OF SODIUM BETWEEN 78°K AND 372°K. F.J.Bradshaw and S.Pearson.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 441-8 (April, 1956).

The resistivity was measured to slightly beyond the melting point and results compared with those from previous determinations. There was a small inflection in the curve of resistivity/temperature against temperature at about 250°K which could not be simply explained on present conductivity theories and the hypothesis that part of the high temperature resistance is due to lattice defects is considered. The measurements on solid sodium were taken to within 0.04 deg of the melting point and no further anomalies were found. Attempts were made to measure excess resistivity due to defects retained after quenching the solid from temperatures near the melting point or after mechanical deformation at 63°K, but any defects so formed proved too mobile for their retention to be possible. A.

537.311.33

5087. INVESTIGATIONS OF THE MECHANISM OF CONDUCTIVITY IN INTERMETALLIC COMPOUNDS. H.Bruns and G.Lautz.
Ericsson Tech., Vol. 11, No. 2, 227-40 (1955).

Some of the problems of conduction in the intermetallics are outlined, and the properties of the system Zn—Sb, the compound InBi, and of $Au_2Bi$ and $AuSb_2$ are described. A bibliography listing recent Russian work in the field is included. C.A.Hogarth

537.311.33

5088. DEMONSTRATION OF AN EQUATION OF CONDUCTIVITY IN THE SOLID STATE. J.G.Barredo.
Naturwissenschaften, Vol. 43, No. 3, 51-2 (1956).

It is claimed that when a voltage is applied to a semiconductor the high resistance commonly associated with the semiconductor does not appear immediately. A lower resistance is observed described by the equation $I = KN^{\alpha}t^{-1/2} + V/R$ where I is current, N carrier density, V voltage, R the steady resistance, t time, and $\alpha$ the order of reaction of the carriers. Experiments using applied pulses on germanium, silicon, and selenium rectifiers give a value of exactly 2 for $\alpha$,
C.A.Hogarth

537.311.33

5089. TEMPERATURE-DEPENDENT FACTOR IN CARRIER LIFETIME. R.L.Longini.
Phys. Rev., Vol. 102, No. 2, 584-5 (April 15, 1956).

The rapid recombination observed to occur at dislocations occurs because of a relaxation of momentum selection rules. The then observed lifetime $\tau$ is related to a fundamental process lifetime $\tau_d$ by the relation $\tau = \tau_d \exp(-\phi/kT)$ where $\phi$ is of order 0.2 eV. The variation of $\tau_d$ with temperature must be slow. C.A.Hogarth

537.311.33

5090. QUANTUM THEORY OF CYCLOTRON RESONANCE IN SEMICONDUCTORS: GENERAL THEORY. J.M.Luttinger.
Phys. Rev., Vol. 102, No. 4, 1030-41 (May 15, 1956).

The most general form of the Hamiltonian of an electron or hole in a semiconductor such as Si or Ge, in the presence of an external homogeneous magnetic field, is given. Two methods of obtaining the corresponding energy levels are discussed. The first should yield very accurate values for the magnetic field in the (111) direction for either Si or Ge. The second is a perturbation method and is expected to give good results only for Ge. A.

537.311.33

5091. DEGENERATION OF THE ELECTRON GAS IN SEMICONDUCTORS. A.G.Samoĭlovich and L.L.Korenblit.
Uspekhi fiz. Nauk, Vol. 57, No. 4, 577-630 (1955). In Russian.

The paper gives a comprehensive survey of the topic including a discussion of such matters as: the equilibrium of electrons and holes in a semiconductor, the temperature variation of chemical potential in semiconductors, the scattering of electrons on the ions of an admixture impurity in degenerated semiconductors, comparison of theory and experiment, some unsolved problems. 42 refs.
C.R.S.Manders

537.311.33 : 535.343

5092. ELECTRICAL AND OPTICAL PROPERTIES OF A SEMICONDUCTING DIAMOND. I.G.Austin and R.Wolfe.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 329-38 (March 1, 1956).

The electrical resistivity and Hall coefficient of a semi-



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conducting diamond (Type IIb) have been measured between $-100^{\circ}$C and $600^{\circ}$C using standard d.c. methods. The diamond behaves like a normal p-type semiconductor. At $20^{\circ}$C its resistivity is 270 ohm cm and the Hall mobility of the holes is $1550 \pm 150$ cm$^2$volt$^{-1}$sec$^{-1}$. Near this temperature the mobility varies approximately as $T^{-3/2}$. The activation energy of the acceptors is 0.38 eV. It is suggested that these acceptors are impurity atoms and that the total concentration of impurities is smaller in Type IIb diamonds than in other diamonds. The infrared absorption spectrum of this diamond is typical of Type II diamonds but it shows an additional prominent peak at 3.57 $\mu$, smaller peaks at 4.1 $\mu$, 3.4 $\mu$ and 2.5 $\mu$, and a continuum of absorption in the range 1 to 2.5 $\mu$. This extra absorption is reversibly temperature dependent. The intensity decreases with increasing temperature and the peaks are undetectable above $300^{\circ}$C. At $-155^{\circ}$C, photocurrents of the order of $10^{-9}$ amp have been detected in the wavelength range 0.9 $\mu$ to 3.6 $\mu$. A tentative model is proposed to relate this photoconductivity and the major absorption peak to the mechanism of conduction. A.

537.311.33

5093. A NOTE ON THE THEORY OF DISLOCATION IN GERMANIUM. T.Shindo.
J. Phys. Soc. Japan, Vol. 11, No. 3, 331-2 (March, 1956).

A development of W.T.Read's theory of the electron traps associated with edge dislocations (Abstr. 9754/1954). Formulae for the occupation probability of these centres are obtained, using the principle of detailed balance, (a) for high temperatures where chemical donors are completely ionized and (b) for low temperatures where no electrons are excited into the conduction band. The calculation neglects electrostatic interactions between occupied centres and so corresponds to Read's "Fermi statistics" approximation. A.B.Lidiard

537.311.33 : 539.166.9

5094. EFFECTS OF GAMMA RADIATION ON GERMANIUM. J.W.Cleland, J.H.Crawford, Jr and D.K.Holmes.
Phys. Rev., Vol. 102, No. 3, 722-4 (May 1, 1956).

High-purity n- and p-type samples of Ge have been exposed to $\gamma$-rays from a 900-curie $Co^{60}$ source. The extrinsic electron concentration of n-type material decreases at a rate only $\sim 10^{-3}$ of that for fast-neutron irradiation. Two electron trapping levels which are apparently identical to those produced by fast neutrons have been observed. Extended exposure converts n-type material to p-type, indicating the presence of an acceptor level at $\sim 0.26$ eV above the valence band. This energy is somewhat larger than that found in material irradiated by fast neutrons. Interstitial clustering and nonuniform defect distribution are believed to lower the energy levels produced by fast neutrons; hence energetic photons apparently produce randomly distributed defects throughout the volume of the specimen. Exposure of p-type material causes a decrease of extrinsic hole concentration with a removal rate much less than that for n-type Ge. The cross-section for atomic displacements obtained from these results is $\sim 1.5 \times 10^{-26}$ cm$^2$. This value is in reasonable agreement with the calculated cross-section expected for the Compton electrons and photoelectrons produced by $Co^{60}$ $\gamma$-ray absorption in Ge. A.

537.311.33 : 538.63

5095. LOW TEMPERATURE MAGNETORESISTANCE ANOMALIES IN INDIUM ANTIMONIDE. I.M.Mackintosh.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 403-6 (March, 1956).

Gives a possible explanation for the observed negative magnetoresistance of InSb below about $8^{\circ}$K (Abstr. 7955/1955), based on the effects of changes in the concentrations of conduction electrons due to a splitting of the impurity levels in a magnetic field. E.P.Wohlfarth

537.311.33 : 538.63

5096. POPULATION CHANGES WITH MAGNETIC FIELD. K.W.H.Stevens.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 406-7 (March, 1956).

Gives an alternative derivation of the relation for the change of the number of conduction electrons in a semiconductor in a magnetic field generalizing that given in the preceding abstract. The ratio $\Delta n/n$ is shown to be proportional to $(\mu H/kT)^2$. E.P.Wohlfarth

537.311.3

5097. CONDUCTIVITY MEASUREMENTS ON HIGH PURIT SELENIUM. F.Eckart.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 84-93 (1956). In German.

Highly purified selenium was melted down several times in a high vacuum and resistance-temperature measurements were carried out in the narrow range $18-40^{\circ}$C. Activation energies in the range 1.2 to 1.6 eV were obtained, the value depending on the pre-treatment. After warming in air the co ductivity increased by about 6 orders of magnitude and the activation energies were reduced to 0.14 to 0.19 eV. The change in properties is believed due to the effect of oxygen from the atmosphere. C.A.Hogarth

537.311.33 : 621.317.33

5098. THE MEASUREMENT OF THE ELECTRICAL RESIS IVITY OF SILICON. R.H.Creamer.
Brit. J. appl. Phys., Vol. 7, No. 4, 149-50 (April, 1956).

A modified 4-probe method is described which employs probes made from wires containing a donor or acceptor type impurity for n- or p-type silicon respectively. By dischargin a condenser between the probes, low-resistance stable contacts are obtained which allow a steady current to flow in the specimen and permit the potential to be measured with a standard potentiometer. Resistivity measurements by the normal method and by the 4-probe method are compared; the latter measurements give an accuracy of about $\pm$ 7% for resistivities up to several hundred $\Omega$-cm. A.

537.311.33 : 621.316.825

5099. ON THE MODE OF ACTION OF VOLTAGE-DEPENDENT SILICON CARBIDE RESISTANCES. K.Zuckler.
Z. angew. Phys., Vol. 8, No. 1, 34-40 (1956). In German.

Measurements of the voltage–current characteristics of SiC aggregates show a dependence of thermal effects, such as hysteresis, forming, and diffusion, on time and current strength. These observations are readily explained as a result of self-heating of the resistance due to the passage of the current. Single crystals do not show a thermal- or field-dependent effect on their contact properties at various temperatures. C.A.Hogarth

537.311.33

5100. THE SEMICONDUCTING PROPERTIES OF $ZnAs_2$. C.Fritzsche.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 94-101 (1956). In German.

The preparation, X-ray examination and measurements of the temperature variation of electrical conductivity of samples of $ZnAs_2$ containing varying proportions of arsenic are described. $ZnAs_2$ is a p-type semiconductor, shows rectification effects against a whisker contact, and in the specimens examined Hall effect measurements yielded values of about $10^{20}$ cm$^{-3}$ for the carrier concentration. C.A.Hogarth

537.311.33

5101. ADSORPTION AND SURFACE POTENTIAL OF SEMICONDUCTORS. II. SURFACE VACANCIES AND ITS REACTION WITH OXYGEN ON ZnS. A.Kobayashi and S.Kawaji.
J. Phys. Soc. Japan, Vol. 11, No. 4, 369-75 (April, 1956).

The surface potential and its change with illumination for the (110) cleavage surface of zinc blende have been measured. It was found that electron trap centres were created near the surface of the crystal, when the crystal was heat treated in vacuum, and these traps were diminished by the reaction with

oxygen. The traps are attributed to sulphur vacancies which are formed by evaporation of sulphur component by the following reasons (1) the higher the temperature of heat treatment in vacuum, the larger the number of traps, and (2) after heat treatment at 350° C for 4 hours in vacuum, the surface becomes charged positively. It is concluded that oxygen reacts with these traps, causing the surface to be negatively charged. An overall change of surface potential in the range between the initial and saturated adsorption agrees fairly well with the initial heat of adsorption observed, as expected theoretically. A.

537.311.33

5102. SIMPLE METHOD OF REVEALING P-N JUNCTIONS IN GERMANIUM. R.W.Jackson.
J. appl. Phys., Vol. 27, No. 3, 309-10 (March, 1956).

An electrolytic etching technique is described which makes use of the fact that a rectifying barrier is formed between n-type Ge and an electrolyte, whilst no barrier is formed for p-type Ge. Thus if a crystal surface containing p- and n-regions is placed in contact with an etchant [10% NaOH is used], and suitable potentials are applied, the p-type regions are preferentially etched and p-n junctions revealed. D.G.Avery

537.311.33

5103. EFFECT OF VACUUM HEATING AND ION BOMBARDMENT OF GERMANIUM ON POINT CONTACT RECTIFICATION. R.B.Allen and H.E.Farnsworth.
J. appl. Phys., Vol. 27, No. 5, 525-30 (May, 1956).

An apparatus is described which allows the cleaning of the contact surfaces by vacuum heating and argon ion bombardment. The diode characteristics of a tungsten and a niobium point against the same germanium crystal are measured while a high vacuum is maintained in the experimental tube. If the germanium is heated to above 800° C and cooled suddenly, the room-temperature rectification is lost. The rectification is restored by vacuum annealing at 500° C for 10 hr. The best rectification characteristic is obtained after the germanium has been subjected to a long anneal, argon ion bombardment, and a short anneal. This sequence of treatments approximates that yielding the low-energy electron diffraction pattern to be expected from a pure germanium surface. The diode activation potential, determined from the temperature dependence of the low-level resistance, is shown to change experimentally with the treatment of the semiconductor and with the contact force. With the techniques used, an experimental dependence of the diode activation potential on the metallic work function is not evident. A theoretical expression for the activation potential is given in an appendix. A.

537.311.35

5104. THE ELECTRICAL CONDUCTIVITY OF CHLOROBENZENE. J.Hart and A.G.Mungall.
Canad. J. Phys., Vol. 34, No. 5, 491-7 (May, 1956).

Measurements of the conductivity of chlorobenzene in evacuated cells of identical geometry but with different electrode metals have shown that the conductivity measured is dependent on the electrode metal employed. The degree of dependence is more marked and the conductivities are one or two orders of magnitude larger in the presence of air. Preliminary measurements of small discharge currents in a cell with monel metal electrodes are also described. A.

537.312.5

5105. ON A PHOTOELECTROMOTIVE FORCE DEPENDENT ON THE DIRECTION OF LIGHT INCIDENT ON POLYCRYSTALLINE LEAD SULPHIDE LAYERS. G.Schwabe.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 249-62 (1956). In German.

PbS layers, produced with a standard method in air, gave rise on illumination to milli-voltages depending on the angle of incidence of a narrow probing beam. A negative angle reversed the sign of the voltage. The curve voltage-angle was not symmetrical about the origin owing to the influence of a temperature gradient during the formation of the layer. Saturation effects were observed when two light probes were used. Rough substrates led to an increase in sensitivity. The effect is explained by assuming that oxygen does not penetrate the PbS layer during its formation but stays on its surface. It will receive, from the interior of the crystallites, electrons which leave behind positive lattice defects. Thus the surface becomes negative with respect to the interior and the electron pairs formed on illumination are separated in the existing boundary field, giving rise to a photo-voltage. R.A.Weale

537.312.5

5106. QUENCHING OF PHOTOCONDUCTIVITY IN CADMIUM SULFIDE. S.Tutihasi.
J. Opt. Soc. Amer., Vol. 46, No. 6, 443-8 (June, 1956).

The spectral distribution and the temperature dependence of the photoconductivity in cadmium sulphide crystals have been investigated. Taft and Hebb reported two quenching bands in the infrared region and suggested that infrared radiation excites trapped holes from their ground states to levels of higher energy, from which the excited holes ionize thermally and recombine with trapped electrons. In the present experiments, the following has been observed. Of the two quenching bands which are resolved at room temperature in 'pure' crystals, one, the 1.4-micron band, is no longer resolved at −75° C and lower, although some quenching is still observed in this wavelength region at −185° C. In copper-doped crystals, on the other hand, only one quenching band has been observed, at 1.4-microns, which completely disappears at temperature below −80° C. These results imply that the quenching process at the 1.4 micron peak involves excitation of the trapped holes and thermal ionization of the excited holes. The quenching peak at 0.9 micron, on the other hand, remains at −185° C in 'pure' crystals, although the quenching efficiency reduces to some extent. Addition of infrared radiation to green light on CdS crystals causes at first a transient increase in photoconductivity in the crystals followed by a decay. Measurements of the temperature dependence of this infrared stimulation of photocurrent have been carried out. The results, together with the results of 'glow curve' measurements, indicate that the transient increase in photoconductivity on application of infrared radiation is due to the temporary increase of conduction electrons created by infrared light which ejects trapped electrons from traps into the conduction band. A.

537.312.5

5107. PHOTOEFFECT QUANTUM YIELD IN SILVER BROMIDE CRYSTALS. M.S.Egorova and P.V.Meĭklyar.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 60-7 (1956). In Russian.

The quantum yield of the photoeffect in silver bromide has been determined. It is shown that the quantum yield decreases with increasing concentration of electron liberating centres. A.

537.312.62

5108. MAGNETIC ENERGY AND ELECTRON INERTIA IN A SUPERCONDUCTING SPHERE. E.G.Cullwick.
Proc. Instn Elect. Engrs, Monogr. No. 184, publ. June, 1956, 6 pp. To be republished in Part C.

The hypothesis that the magnetic energy of a current circuit is the kinetic energy of the effective conduction electrons, developed in a previous Monograph, Abstr. 1397 (1956), is applied to the case of a conducting sphere without resitivity in a uniform magnetic field. A surface current is induced which prevents the growth of a magnetic field within the sphere, and expressions are found for the number and velocity of effective conduction electrons which carry the current. It is found that these electrons are in stable radial equilibrium, moving in circular orbits under the action of magnetic forces. The well-known Meissner effect in pure superconductors is shown to be an expected rather than an unexpected phenomenon, since its absence would require, under certain conditions, a super-

current lacking equilibrium. The theory is shown to lead, by means of a simple assumption, to the basic equations of the London theory of superconductivity, but with a different interpretation of the velocity parameter. Finally, the inertial supercurrent and magnetic field which should be produced by the steady rotation of a superconducting sphere, as deduced by the new theory, are shown to be exactly the same as those forecast by the London theory. A.

537.312.62

5109. PARAMAGNETIC EFFECT IN SUPERCONDUCTORS. III. MEASUREMENTS ON HOLLOW CYLINDERS OF MERCURY AND TIN. H.Meissner.
Phys. Rev., Vol. 101, No. 6, 1660-7 (March 15, 1956).

For Pt II, see Abstr. 4681 (1955). The circular flux which is set up by a longitudinal current passing through a hollow cylinder has been measured in the intermediate state by ballistic and fluxmetric methods. The flux has a maximum in the transition region and drops to zero in the pure superconducting state, which is in qualitative agreement with theoretical predictions. The dependance of the maximum of the flux increase on the current and on the ratio of the inner to the outer diameter of the sample was found to be different from the theory. It was found, in particular that the ratio $K_{m\varphi}$ of the maximum flux, $\Phi_{max}$, to the flux in the normal conducting state $\Phi_n$ is not independent of the current. It is not possible to correct the theory from these measurements alone. However, it seems very likely that the correction which has to be applied here is intimately connected with the correction term $1 - I_g/I$ which has to be applied to the theory of the paramagnetic effect. It was further found that the value of the maximum of the circular flux does not change if a longitudinal magnetic field is superimposed. This is in line with theoretical predictions. The longitudinal field intensity in the hole and the resistance of the sample were also measured and the results compared with the present theory. The technique of introducing currents up to 15 A into the cryostat and an all-metal Dewar vessel are described. A.

537.312.62 : 538.222

5110. PARAMAGNETIC EFFECT IN SUPERCONDUCTING TIN, INDIUM, AND THALLIUM. J.C.Thompson.
Phys. Rev., Vol. 102, No. 4, 1004-8 (May 15, 1956).

Measurements have been carried out on the longitudinal magnetization of pure rods in the intermediate state between normal and superconduction. The observed "paramagnetic" flux increase is dependent on the externally sustained current, external magnetic field, and temperature only. The dependence is much the same for the metals studied. There is a threshold current to be exceeded before the flux increase is observed. The threshold is linearly dependent on the external magnetic field; the slope of the threshold curve is the same for the metals studied. The results compare favourably with existing theory, except for the threshold. An upper limit has been placed on the relaxation time for the currents responsible for the flux increase. The effect of the physical purity of the sample has been observed. A.

537.312.62

5111. LIFETIME OF POSITRONS IN SUPERCONDUCTING LEAD. B.Green and L.Madansky.
Phys. Rev., Vol. 102, No. 4, 1014-15 (May 15, 1956).

Comparison of the mean lifetime of positrons in lead at 4.2°K with that at 10°K indicates (a), no change greater than $2 \times 10^{-10}$ sec in the short-lived component, and (b), no more than 0.3% abundance of a component with lifetime greater than $2 \times 10^{-9}$ sec. A.

537.312.62

5112. THE STRUCTURE OF SUPERCONDUCTORS. IX. X-RAY DETERMINATION OF THE STRUCTURE OF $\alpha$-$Bi_4Rh$. V.P.Glagoleva and G.S.Zhdanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 248-51 (1956). In Russian.

For Pt. VIII see Abstr. 7974 (1955). The structure of the low-temperature modification of $Bi_4Rh$ belonging to the $O_h^{10}$ — Ja3d space group with a lattice period of a = 14.928 A has been determined. By a method of constructing the cross-sections and projections of the interatomic vector rows ($F^2$-rows) and electron density rows (F-rows) it has been possible to determine the position of the bismuth and rhodium atoms. A.

537.312.62 : 536.631

ATOMIC HEATS OF SUPERCONDUCTING TIN AND VANADIUM. See Abstr. 4372-3

537.312.8 : 538.63

5113. INTERRELATION BETWEEN ANISOTROPY OF THE HALL EFFECT AND VARIATION OF THE RESISTANCE OF METALS IN A MAGNETIC FIELD. I. INVESTIGATION OF ZINC. E.S.Borovik.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 262-71 (1956). In Russian.

The dependence of the Hall field strength and of resistanc on the angle between the sixth-order symmetry axis and direc tion of the magnetic field has been investigated at magnetic field strengths up to 25 000 Oe and temperatures of 4° and 20° The possibility of interpreting the results from the standpoint of modern theory is considered. A

537.312.9

5114. STUDY OF SOME PROPERTIES OF THIN STRIPS AND FINE WIRES. I.Epelboin.
J. Phys. Radium, Vol. 16, No. 12, 80 S-81 S (Dec., 1955). In French.

The effect on resistivity and permeability of removing surface layers of strips and wires by electropolishing has been studied. A study has also been made of the variations in these properties when electropolished fine wires are subjected to a pull at one end. G.F.Hodsman

537.323

5115. ON THE THERMOELECTRIC POWER OF DILUTE METALLIC ALLOYS. A.B.Bhatia and D.K.C.MacDonald.
Canad. J. Phys., Vol. 34, No. 4, 419-22 (April, 1956).

The quantity $\partial \log \rho_0 / \partial \log E$ where $\rho_0$ is the resistivity of a metal due to impurities and imperfections and E is the Fermi energy, is discussed. By choosing the correct form for the potential of an impurity ion the possible range of values of $\partial \log \rho_0 / \partial \log E$ is much increased. C.A.Hogarth

## ELECTRIC DISCHARGES 537.52

537.52 : 537.221

5116. "CONTACT" PHENOMENA IN PLASMA. L.A.Sena and N.S.Taube.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 287-90 (1956). In Russian.

Potential discontinuities at the boundaries between various parts of a plasma differing in electron concentration and temperature are considered from the standpoint of classical contact potential theory for metals. The validity of this treatment is confirmed by measurements carried out in a discharge tube in which two parts of the positive column differ with respect to electron concentration. A.

537.521

5117. INVESTIGATION OF THE HIGH FREQUENCY DISCHARGE. G.M.Pateyuk.
Zh. eksper. teor. Fiz., Vol. 30, No. 1, 12-17 (1956). In Russian.

The dependence of the ignition and operating potential in argon, neon and hydrogen on the gas pressure and geometry

f the discharge space has been investigated in the frequency ange from 57 to 500 Mc/s. It was found that the boundary onditions on the electrodes and walls of the discharge tube ignificantly influence the ignition and operating potential. Vith increase of the alternating field frequency from 57 to 00 Mc/s the ignition and operating potential pressure depend- nce curves for hydrogen, argon and neon shift towards igher potentials, whereas the minima of these curves shift owards higher gas pressures. A range of critical frequencies as been found for hydrogen; within this range the ignition otential is practically independent of the gas pressure as the ield frequency is changed. The results of this investigation gree with the conclusions of the diffusion high-frequency ischarge theory. A.

537.521 : 539.17

THERMONUCLEAR FUSION. GAS DISCHARGE RESEARCH N THE SOVIET UNION. See Abstr. 4627

537.521.7 : 621.3.015.54

5118. THE CRITERION OF SPARKING FOR EXTREMELY LARGE VALUES OF THE PRODUCT: (GAS PRESSURE X GAP LENGTH). S.Nagao.
J. Inst. Elect. Engrs Japan, Vol. 75, 121-4 (Feb., 1955). In Japanese.

This criterion is derived and compared with sparking voltages measured by Trump and his co-workers. It is concluded that a certain portion of the air gap length, determined by Meek's criterion, plays an important role in the sparking and that photo-ionization arises chiefly from photons of lower-energy than that associated with the ionization potential of the gas emitting photoelectrons from the cathode surface. The criterion is expressed as: $\log p^2/x = A(p/x - B)$ where x is the sparking field strength and A, B are constants determined by the physical properties of the gas and the cathode metal.
H.G.M.Spratt (R)

537.523.4 : 537.527.4 : 621.319.51

5119. A NEW HIGH-FREQUENCY SPARK APPARATUS FOR LONG SPARK TRAINS (25 000/SEC), AND THE APPLICATION OF CONTROLLED SINGLE SPARKS IN "VOLTAGE OPTICS". E.Früngel.
Z. angew. Phys., Vol. 8, No. 2, 86-90 (1956). In German.

Describes, with a full circuit diagram, a spark source for the provision of illumination for high-speed flash photography. Various applications are illustrated and discussed.
J.D.Craggs

537.523.5

5120. THE CATHODE AND ANODE FALLS IN WALL STABILIZED ARGON ARCS. B.Winde.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 263-8 (1956). In German.

Describes measurements of anode and cathode falls in argon arcs (300-1000 mm Hg, with currents varying between 5 and 40 A). The results are briefly discussed in reference to other published work. J.D.Craggs

537.523.5

5121. OBSERVATIONS OF CATHODE ARC TRACKS. H.S.Dunkerley and D.L.Schaefer.
J. appl. Phys., Vol. 26, No. 11, 1384-5 (Nov., 1955).

Describes the appearance of the cathode surface following operation of a pulsed arc in air at atmospheric pressure. An arc moved along by a suitable magnetic field gave a series of discrete cathode spots; a qualitative explanation of this phenomenom is given. J.D.Craggs

537.523.5 : 536.5

5122. DETERMINATION OF ARC TEMPERATURES USING SHOCK WAVES. D.Whittaker and H.Edels.
Nature (London), Vol. 177, 484-5 (March 10, 1956).

The earlier sound-wave transit method of measuring gas temperatures of discharges, notably arcs, introduced by Suits has been re-applied. The authors have shown that the method essentially involves shock waves, and have developed the necessary theory for the case of a shock passing through a region in which there is a continuously varying temperature.
J.D.Craggs

537.523.5 : 537.562

5123. DETERMINATION OF THE ABSOLUTE CONCENTRATIONS OF ATOMS IN A MULTI-COMPONENT ARC VAPOUR. V.S.Mel'chenko.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 628-9 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 564-5 (Nov., 1955).

Describes a spectroscopic method, based on Saha's equation, for the determination of neutral atom densities in mixed vapours. The method involves the measurement of the degree of ionization of one component and the gas temperature. The theory is applied to the case of Mg–Zn in an arc running at 6300° K. Experimental results are given. J.D.Craggs

537.525

5124. THE POSITIVE COLUMN IN A LONGITUDINAL MAGNETIC FIELD. R.J.Bickerton and A. von Engel.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 468-81 (April, 1956).

A magnetic field parallel to the axis of the positive column of a discharge is known to impart a rotary component on the radial motion of electrons. This reduces the flow of both positive ions and electrons to the wall, causing a corresponding decrease in the radial and longitudinal components of the electric field and in the electron temperature. It is shown here that under certain conditions Langmuir probes can be applied to explore a plasma in a magnetic field. A new method of measuring the concentration of charges is used: first relative values of ion concentration are obtained from the ion saturation currents in various magnetic fields. This result together with the electron saturation currents in zero magnetic field gives absolute values of concentration of charges in a magnetic field. Such measurements have been carried out in helium at low pressures. The effect of the magnetic field on the radial distribution of charges, the rate of ionization, the electric field, the electron temperature, the average energy loss in a collision, and the radial potential distribution is discussed. It is concluded that in zero magnetic field the Langmuir theory of free ion fall describes best the properties of the discharge plasma whereas in a magnetic field of sufficient strength Schottky's theory of ambipolar diffusion applies. When the gas becomes highly ionized, the effect of the partial pressure of the electron gas may become important so that finally both the longitudinal component of electric field and the electron temperature should become independent of the magnetic field. Previous observations of a low pressure positive column in caesium at high current densities seem to support this view. A.

537.525

5125. INVESTIGATION OF CATHODE SPUTTERING IN THE NEAR THRESHOLD REGION. I. N.D.Morgulis and V.D.Tishchenko.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 54-9 (1956). In Russian.

Labelled atoms were used to determine the magnitude of the sputtering threshold energy. Results of an experimental study of sputtering of cobalt labelled with $Co^{60}$ due to mercury or argon ions are presented. A.

537.525

5126. INVESTIGATION AT LOW GAS PRESSURE OF AN INTERMEDIATE-FREQUENCY DISCHARGE OCCURRING BETWEEN HIGH-FREQUENCY AND LOW AUDIO-FREQUENCY DISCHARGES. N.A.Popov and N.A.Kaptsov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 68-76 (1956). In Russian.

The position of the lower frequency limit of high-frequency

discharges in hydrogen, neon and krypton at a pressure of several mm Hg has been investigated experimentally. An intermediate frequency range lying between those of high frequency and alternating low audio-frequency discharges has been found which possesses the properties of both types of discharge; the lower frequency boundary of the transition range lies at about several hundred c/s. The time dependence of the intensity of the discharge plasma radiation during deionization has been measured for hydrogen and krypton; it is shown that the duration of deionization is the main factor determining the transition from an alternating current discharge to a high-frequency one with increasing frequency. A.

537.525.8

5127. ON THE THEORY OF THE CATHODE FALL IN GLOW DISCHARGES. J.Wilhelm.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 225-32 (1956). In German.

Gives references to recent work in this field, develops a simple theoretical treatment and shows curves relating potential/distance and electrical-field/distance for hydrogen and argon at pressures ~1 mm Hg. J.D.Craggs

537.525.8

5128. THE PULSING OF AN H.F. DISCHARGE WITH A ZIRCONIUM FILAMENT. J.Desjonquières, R.Geller, F.Prévot and R.Vienet.
J. Phys. Radium, Vol. 17, No. 2, 166-7 (Feb., 1956). In French.

Discusses briefly the conflicting requirements, in ion sources, of high ion beam current and low gas pressure and shows how the pressure in an h.f. ion source may be pulsed by discontinuous heating of a zirconium filament mounted above the discharge space in the source chamber.

J.D.Craggs

537.528

5129. MECHANISM OF ELECTRICAL BREAKDOWN IN SATURATED HYDROCARBON LIQUIDS. T.J.Lewis.
J. appl. Phys., Vol. 27, No. 6, 645-50 (June, 1956).

There have been several investigations of the electrical breakdown strength of hydrocarbon liquids in a high state of purity in which attempts have been made to correlate the strength with density or chain length. A simple relationship between these quantities did not exist when branched-chain isomers of the n-paraffins were included. The present paper develops the theory of breakdown outlined previously in which molecular vibrations in these liquids can provide an energy barrier to ionization by electrons and final breakdown. It is suggested that three major processes occur, namely, electron emission from the cathode, energy loss to molecular vibrations, and ionization of the liquid. The instability which marks breakdown is then induced by positive ions which result from ionization. Provided a suitable test procedure is employed it is possible to compare the energy-loss mechanism in the various liquids by comparing their electric strengths. The nature of the molecular vibrations is discussed, and it is suggested that the infrared frequencies of the $CH_3$, $CH_2$, and CH groups undergoing bond stretching are excited by the electron motion. Such a frequency, characteristic of the carbon–hydrogen bond would be common to all hydrocarbon liquids. Collision cross-sections for these groups can then be assigned and a breakdown criterion set up which is analogous to that proposed by von Hippel for condensed phases. The general correctness of this theory is illustrated by reference to the measurements of Crowe, Sharbaugh, and Bragg and to new measurements obtained by the author. It is found to be possible to correlate not only the electric strength of straight-chain hydrocarbons but branched-chain isomers as well. Finally it is suggested that the current pulses frequently observed in conduction measurements in n-hexane are possibly associated with bond deformation vibrations. A.

537.529 : 621.316.923

5130. ELECTRIC EXPLOSION OF METALLIC WIRES. I.F.Kvartskhava, A.A.Plyutto, A.A.Chernov and V.V.Bondarenko.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 42-53 (1956). In Russian.

Electric explosion of wires has been investigated by current and voltage oscillography and by shadow photography. It is shown that the energy release in the wire during the first current pulse may be either less or considerably more than that required for complete evaporation of the wire. Shadow pictures of successive stages of the wire explosion are presented; these show that after passage of the first current pulse the material of the wire becomes highly dispersed. A qualitative interpretation of the main features of wire explosion phenomenon is given which takes into account the strong mechanical strains due to heating of the wire and also radial pressure due to the magnetic field of the current. A

## X-RAYS 537.531

537.531 : 537.533.9

5131. ELECTRON OPTICS OF X-RAY TUBES AND THE DESIGN OF UNBIASED SHARPLY-FOCUSING CATHODES. A.R.Lang and D.A.G.Broad.
Brit. J. appl. Phys., Vol. 7, No. 6, 221-6 (June, 1956).

Using an accurate rubber model, electron trajectories produced by both conventional and various special X-ray tube cathode systems have been studied. Excellent agreement between predicted and observed focal patterns was obtained, in contrast to the results of electrolytic trough measurements reported by Thorp. In conventional cathode systems the effect of space charge were shown to be negligible. A simple unbiased cathode assembly was designed which gave a sharply bounded focal line of width 1 mm. A.

537.531 : 535.343

5132. L FLUORESCENCE SPECTRUM OF PLUTONIUM. Y.Cauchois and I.Manescu.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1433-6 (March 12, 1956). In French.

An extension of the earlier work (Abstr. 2781/1955). A photograph of the spectrum shows several lines, which have been identified and measured by comparison with the wavelengths of K-spectrum lines of the elements of atomic number 35 to 48. The wavelengths of nineteen L lines, in X.U., are tabulated. J.J.Phipps

537.531 : 535.343

5133. SPECTRAL DISTRIBUTION OBSERVED IN A REGION OF CHARACTERISTIC (PROPRE) ABSORPTION OF QUARTZ. Y.Cauchois and C.Bonnelle.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1596-9 (March 19, 1956). In French.

Extension of previous work (Abstr. 2913/1956) to a quartz crystal, cut parallel to the 1010 plane, in the region of the K absorption edge of silicon. Microphotometer traces are given showing the detailed spectral distribution, and the structure briefly discussed. J.Hughes

537.531 : 535.343

5134. AN ATTEMPT AT A THEORETICAL INTERPRETATION OF THE ANOMALOUS SCATTERING OF X-RAYS BY CRYSTALS. Y.Heno.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1599-602 (March 19, 1956). In French.

A general quantum theory of coherent atomic scattering was developed and the scattering probability is given. On applying the theory to scattering from quartz in the region of the K absorption frequency of silicon, qualitative agreement is

obtained with recent experimental results (preceding abstract).
J.Hughes

537.531 : 535.345

5135. MASS ABSORPTION COEFFICIENT OF CARBON FOR CuK$\alpha$ RADIATION. D.R.Chipman.
J. appl. Phys., Vol. 26, No. 11, 1387 (Nov., 1955).

Hitherto accepted values, obtained from "good geometry" transmission measurements on graphite, are too high because of small angle scattering. Measurements on paraffin, polystyrene and graphite, using variable geometry, yield 4.15 (±.1) $cm^2g^{-1}$. R.S.Pease

537.531 : 535.33

5136. ON SCREENING CONSTANTS IN X-RAY SPECTRA. R.C.Karnatak and Y.P.Varshni.
Z. Phys., Vol. 145, No. 3, 341-6 (1956).

Fresh calculations of the X-ray screening constants $\sigma_2$ for $L_{II}L_{III}$, $M_{II}M_{III}$ and $M_{IV}M_V$ have been made. It has been found that $\sigma_2$ is not absolutely constant for different Z. Some regular variations in $\sigma_2$ with electronic shell structure have been noted. A.

537.531 : 621.386.1

5137. AN X-RAY IMPULSE TUBE WITH SYNTHETIC INSULATOR AND A DOUBLE ANODE. D.Elle.
Z. angew. Phys., Vol. 8, No. 2, 81-5 (1956). In German.

A demountable tube 20 cm long, working up to 140 kV from a Marx circuit, is described. Leguvals insulation is employed, and the tube contains two anodes 2 cm apart to give simultaneous radiation for stereographic work. Exposure times are less than 1 $\mu$sec. F.T.Farmer

## CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533 : 621.384.613 : 621.316.728

5138. AN APPARATUS FOR THE ACCURATE CONTROL OF THE PEAK X-RAY ENERGY OF A 20 MeV BETATRON. K.Phillips.
Brit. J. appl. Phys., Vol. 7, No. 4, 129-36 (April, 1956).

Two methods are described in detail. In the first method a current transformer supplies a reference voltage in phase with the current in the betatron magnet coils to a trigger and potentiometer control unit. The second method uses a peaking transformer which is connected in series with the betatron magnet coils and supplies a pulse to a differentiating amplifier. The time of firing of the peaking transformer during the acceleration cycle is controlled by means of a high-current, low-voltage stabilizer. The same trigger circuit and expander modulator are used in both methods. A detailed comparison of the performance of the two methods is made. A.

537.533.2 : 539.374

5139. EFFECT OF STRAIN ON THE WORK FUNCTION OF POLYCRYSTALLINE SILVER. G.Wallis and H.E.Farnsworth.
J. appl. Phys., Vol. 27, No. 6, 594-8 (June, 1956).

Contact potential difference measurements in a pressure range from one atmosphere to about $10^{-8}$ mm Hg have indicated that mechanically induced strain of the order of 1% (beyond elastic limit) in polycrystalline strips of silver produces an increase in work function of between 0.01 and 0.03 eV. Annealing at about 400°C for a period of ten minutes approximately restores the original value of work function. Possible explanations of the effect are discussed. A.

537.533.3

5140. BREAKUP OF HOLLOW ELECTRON BEAMS. H.F.Webster.
J. appl. Phys,, Vol. 26, No. 11, 1386-7 (Nov., 1955).

The structure of an electron beam (15.6 V, 0.2 mA) from a hollow cathode in an axial magnetic field of 340 gauss was examined on a moving phosphor screen. The beam breaks up into a discrete number of vortex-like current bundles which increase in size with increasing distance from the cathode.
J.Franks

537.533.335

5141. GENERAL EXPRESSIONS AND CURVES REPRESENTING THE ELECTRON OPTICAL CHARACTERISTICS OF MAGNETIC ELECTRON LENSES. P.Durandeau.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 1710-12 (March 26, 1956). In French.

The focal properties and chromatic aberration constants of magnetic lenses are plotted in the form of universal curves against a parameter proportional to (ampere turns)/(relativistically corrected accelerating voltage)$^{1/2}$, the unit of length being taken as $(S^2 + 0.45D^2)^{1/2}$ (S = spacing, D = diameter of bore). A.E.I. Research Laboratory

537.533.35

5142. PHASE CONTRAST AND INTERCHROMATIC CONTRAST: NEW METHODS OF OBSERVATION IN ELECTRON MICROSCOPY. M.Locquin.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1713-16 (March 26, 1956). In French.

An objective aperture diaphragm with tapered-down edges is used in conjunction with a hollow illuminating beam to increase image contrast. The electrons can lose energy both in the specimen and in the edges of the diaphragm. If the specimen thickness varies from point to point whilst the diaphragm thickness is constant, a variation of contrast can arise from the different energy losses suffered by the electrons from different parts of the specimen. The theory is illustrated by microphotographs. A technique is described for transforming contrast variations in the microphotographs into colour variations. A.E.I. Research Laboratory

537.533.7

5143. INSTABILITY OF ELECTRON BEAMS UNDER A MAGNETIC FIELD. B.Epsztein.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1425-8 (March 12, 1956). In French.

An electron beam travelling parallel to a magnetic field develops instability and splits up into several parts. This is explained as the result of a travelling wave which becomes amplified as the beam progresses, the energy of the wave being derived solely from the mutual repulsions of the electrons. A.E.I. Research Laboratory

537.533.7

5144. ACCELERATION OF ELECTRONS BY AN EXTERNAL FORCE FIELD. E.N.Adams and P.N.Argyres.
Phys. Rev., Vol. 102, No. 3, 605-6 (May 1, 1956).

The usual proof that an electron in an energy band reacts to an external force as though it had an effective mass is shown to be invalid. It is shown, however, that for static externally applied fields, modified (field-dependent) energy bands can be found for which the acceleration theorem is rigorously correct. A.

537.533.74

5145. ON THE STUDY OF THE MULTIPLE SCATTERING OF ELECTRONS WITH THE AID OF NUCLEAR EMULSIONS. M.Maitrot.
J. Phys. Radium, Vol. 16, No. 12, 125S-127S (Dec., 1955). In French.

Measurements on electron tracks (RaE source) in emulsions are described briefly. The results verify Molière's theory for 0.17 to 1.0 MeV electrons, to an accuracy of a few per cent. J.J.Wilkins

537.533.74

5146. THE MULTIPLE SCATTERING OF FAST ELECTRONS. S.Kageyama.
J. Phys. Soc. Japan, Vol. 11, No. 4, 348-51 (April, 1956).

The angular distribution, caused by the multiple scattering, of the fast electron with an energy of 1.66 MeV passing through thin foils of Al, Cu and Pb has been investigated. The experimental results obtained were in good agreement with Molière's theory modified by Hanson et al. on the basis of their experimental data. The theoretical 1/e width values given by Shinohara were also in good agreement with those observed in light elements, but they seem to be slightly larger in heavy elements. A.

537.533.74

5147. INVESTIGATION OF INELASTIC ELECTRON REFLECTION FROM A CUPROUS OXIDE SURFACE. N.B.Gornyĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 160-70 (1956). In Russian.

Inelastic scattering of electrons incident on a cuprous oxide surface has been studied by a method of electric differentiation in a spherical condenser circuit. Inelastically reflected electrons suffering discrete energy losses have been found among the electrons reflected from monocrystalline as well as polycrystalline surfaces. The discrete energy losses equal the energy required to transfer an electron of the crystal lattice from a filled to an allowed zone. It is shown that the appearance of inelastically reflected electrons undergoing discrete energy losses is due to the same mechanism as that responsible for the appearance of discrete groups of genuine secondary electrons previously found by the author. A.

537.533.75

5148. VARIATION WITH ELECTRON ENERGY OF THE COLLISION CROSS SECTION OF HELIUM FOR SLOW ELECTRONS. J.M.Anderson and L.Goldstein.
Phys. Rev., Vol. 102, No. 4, 933-8 (May 15, 1956).

The method of interaction of microwaves in gaseous discharge plasmas has been applied to a determination of the variation of the effective collision cross-section for momentum transfer, $q_m$, of helium atoms with electrons having energies from 0.04 to 0.4 eV. Under experimental conditions with electron densities $\geq 10^{10}$ electrons/cm$^3$, appropriate charge interactions have been considered. The mean fraction of excess energy loss of slow electrons upon collision, G, was found to be $\sim 2.7 \times 10^{-4}$, the expected 2m/M value. A.

537.533.9

5149. AN UNUSUAL ELECTRON SHOWER. Y.K.Lim.
Austral. J. Phys., Vol. 8, No. 4, 562-3 (Dec., 1955).

An event found in a 600 $\mu$ glass-backed emulsion is described. 200 $\mu$ from the origin five tracks are resolved although only 150 $\mu$ from the origin the grain-density is only 3.5 x min. indicating that the fifth track possibly originates 150-200 $\mu$ from the origin. The tracks are probably all electrons and on this supposition the energy almost balances. They are initially contained in a cone of $0.5 \times 10^{-2}$ rad. The event could be the direct creation of an electron pair by an electron in the field of an electron, the fifth track is then interpreted as a knock-on electron. Alternatively it could be double pair production if all tracks originate from the same point. D.J.Prowse

537.533.9

5150. MEASUREMENTS ON HIGH ENERGY ELECTRON SHOWERS. E.Lohrmann.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 820-1 (April, 1956).

Three electron-positron pairs of about 50 BeV (determined by relative scattering) created by the decay of $\pi^0$-mesons emitted from a jet have been examined over a length of $\sim 0.6t$ (t = cascade length). The mean free path for trident production is found to be $1.7 \overset{+1.7}{-0.8}$ t for a mean electron energy of 12 BeV; this is much lower than the theoretical estimate of 9t for 12 BeV and 6t for 40 BeV. The probability of finding the observed number for an assumed m.f.p. of 6t is less than 1%. The showers also show an indication of having too many additional electrons created. The existence of the plateau value of the blob-density at very high energy has been confirmed by measurements on an electron whose lower limit of energy was 1000 BeV. D.J.Prowse

537.533.9

5151. ČERENKOV RADIATION FROM EXTENDED ELECTRON BEAMS NEAR A MEDIUM OF COMPLEX INDEX OF REFRACTION. H.Lashinsky.
J. appl. Phys., Vol. 27, No. 6, 631-5 (June, 1956).

An earlier theoretical treatment of the Cherenkov radiation excited by the passage of a bunched electron beam moving parallel to a dielectric medium at a small distance is extended to the case of a medium with a complex index of refraction. It is found that under suitable conditions, the use of a ferrite material as a medium can in principle enhance the radiated power. This effect is analysed in terms of the work done by the beam on the field and the coupling between the beam and the medium. A.

537.533.9 : 537.534.9

5152. ELECTRODYNAMICS OF MOVING MEDIA AND THE THEORY OF THE ČERENKOV EFFECT. B.D.Nag and Abul Maksud Sayied.
Proc. Roy. Soc. A, Vol. 235, 544-51 (June 19, 1956).

The generalized Frank and Tamm's formula for the total energy radiated as Cherenkov radiation by a swiftly moving charged particle in a medium of dielectric constant $\epsilon$ and permeability $\mu$ has been derived employing the invariance of the phenomenological electrodynamic equations of Maxwell. The scheme is self-consistent, and the idea of the indetectability of the ether wind is contained in it. It is found that the Cherenkov radiation is $\mu$ times larger than that predicted by the Frank and Tamm's formula for $\mu = 1$. Experiments are suggested to detect strong Cherenkov radiation in highly permeable mediums. A.

537.533.9

5153. ON THE QUANTUM THEORY OF A LUMINESCENT ELECTRON. III-IV. A.A.Sokolov and I.M.Ternov.
Zh. éksper. teor. Fiz., Vol. 25, No. 6(12), 698-712 (1953); Vol. 28, No. 4, 431-6 (1955). In Russian.

For Pt II, see Abstr. 8349 (1954). An expression is developed for the quantum corrections to the trajectory of a relativistic electron in a magnetic field with axial symmetry. F.Lachman

537.533.9

5154. ON THE RADIATION EMITTED BY ULTRA-HIGH-VELOCITY ELECTRONS MOVING IN A CONSTANT MAGNETIC FIELD. A.A.Sokolov and A.N.Matveev.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 126-35 (1956). In Russian.

The present paper is a continuation of previous investigations of the quantum theory of the "luminous" electron (see preceding abstract). A formula for the differential radiation spectrum has been obtained which is uniformly correct in any spectral range and for energies of the radiating electron $E \ll E_{1/2} = mc^2(2Rmc/3h)^{1/2}$ as well as for energies $E \cong E_{1/2}$ and $E \gg E_{1/2}$. A closed formula for the total radiation energy which is uniformly valid for arbitrary energies of the radiating electron and also a formula for the "critical" radiation frequency of the "luminous" electron have been obtained. A.

537.534

5155. THE SCATTERING OF PROTONS BY RESIDUAL GAS IN A SYNCHROTRON. I. ELASTIC SCATTERING. J.Seiden.
J. Phys. Radium, Vol. 16, No. 12, 917-25 (Dec., 1955). In French.

Beam losses in a proton synchrotron due to multiple scattering by residual gas are calculated using Molière's theory of multiple scattering. The oscillation amplitudes produced by

the scattering are shown to be proportional to the square root of the pressure and inversely proportional to the square root of the injection energy and the energy gain per turn. Losses due to single scattering are also calculated and applied to three synchrotrons either operating or under construction. For the Brookhaven Cosmotron, losses due to single scattering are shown to be approximately 6.5%, in disagreement with the results of Greenberg and Berlin (Abstr. 5473/1951) and Courant (Abstr. 3573/1954) who estimate the effect of single scattering in the Cosmotron to be negligable. A.J.Egginton

537.534

5156. ELECTROSTATIC DEFLECTION OF A CYCLOTRON ION BEAM. J.Kokame and S.Yamashita.
J. Phys. Soc. Japan, Vol. 11, No. 3, 332-3 (March, 1956).

A differential equation is given for describing ion trajectories through the known fringing field of a cyclotron. Good agreement is obtained between trajectories given by this method and the more conventional step-by-step drawing process. A.J.Egginton

537.534

5157. ATTAINMENT OF VERY HIGH ENERGY BY MEANS OF INTERSECTING BEAMS OF PARTICLES. D.W.Kerst, F.T.Cole, H.R.Crane, L.W.Jones, L.J.Laslett, T.Ohkawa, A.M.Sessler, K.R.Symon, K.M.Terwilliger and N.V.Nilsen.
Phys. Rev., Vol. 102, No. 2, 590-1 (April 15, 1956).

It is pointed out that fixed field alternating-gradient (F.F.A.G.) accelerators may make such intense beams of particles possible that reasonable numbers of interactions could be obtained by directing two beams of equal energy at one another. Two 21.6 GeV accelerators would be equivalent in available energy to one machine of 1000 GeV. Two F.F.A.G. accelerators with beams circulating in opposite directions over 1 m of common straight path would require $5 \times 10^{14}$ circulating particles per $cm^2$ to give $10^7$ interactions per second. It might be possible to build up beams of this order by adding the beams from $\sim 10^3$ successive f-m cycles of r.f. acceleration. J.H.Fremlin

537.534

5158. FIELD DESORPTION. E.W.Müller.
Phys. Rev., Vol. 102, No. 3, 618-24 (May 1, 1956).

Field desorption of barium, thorium, oxygen, and some other adsorbates is studied in a field emission microscope with reversed polarity as a function of field strength, temperature and degree of coverage. The desorption occurs in the 100, 200, and 500 million volts/cm range, for the three substances, respectively. At the highest fields the tungsten substrate itself evaporates at room temperature. The quantitative interpretation of the measurements suggests that field desorption be considered as an evaporation of ions in which the energy hump is reduced by the Schottky effect. A.

537.534

5159. FIELD IONIZATION OF GASES AT A METAL SURFACE AND THE RESOLUTION OF THE FIELD ION MICROSCOPE. E.W.Müller and K.Bahadur.
Phys. Rev., Vol. 102, No. 3, 624-31 (May 1, 1956).

The mechanism of field emission of positive ions is considered as depending upon the supply of molecules and their ionization probability in a field up to 500 million volts/cm. Experimental current-field characteristics match the theoretical curves. The velocity distribution, measured in a retarding potential tube, shows that the ions originate some 5 to 100 A above the surface, depending upon the field. A simple mass spectrometer is described which uses the field emitter as a point ion source. The resolution of the field ion microscope is found to depend upon tip radius, polarizability and ionization potential of the gas, and possibly upon the accommodation coefficient and the temperature. Helium seems to give the best resolution of about 4 A. The possibility of operating a field desorption microscope with sufficient resolution to show the lattice structure of the surface is discussed. A.

537.534.74

5160. VARIATION OF p–p SCATTERING CROSS SECTION WITH ENERGY. Y.P.Varshni.
Naturwissenschaften, Vol. 43, No. 6, 123-4 (1955).

To represent the cross-section in the c.m. system, the empirical formula $d\sigma = 112.5/(E + 0.12) + 2.6$ is proposed, where $d\sigma$ is measured in mb/std and E in MeV. J.Hughes

537.534.75 : 539.164.75

5161. ON THE IONIZATION–ENERGY RELATION FOR ALPHA-PARTICLES IN AIR. R.Ishiwari, S.Yamashita, K.Yuasa and K.Miyake.
J. Phys. Soc. Japan, Vol. 11, No. 4, 337-47 (April, 1956).

To investigate the effect of columnar recombination on the ionization measurement in air, the ratio of the specific ionizations at two fixed residual ranges for polonium alpha-particles was measured with a shallow ionization chamber under various field strengths and angles between the field and the alpha-track. It was found that the observed ratio varies appreciably with varying field strength and angle. It was shown that the observed variation of the ratio can be explained by the effect of columnar recombination and agrees qualitatively with Jaffé's theory. The value of the parameter b in Jaffé's formula, which gives the best agreement with the experiments, was newly determined as $0.5 \times 10^{-4}$ for alpha-particles in atmospheric air. The observed specific ionization curve was corrected for recombination by Jaffé's theory. Then, the corrected curve was integrated and the true ionization–range relation free from recombination was determined. By comparing this relation with the fixed points of the range–energy relation obtained from nuclear reaction data, an empirical formula for the average energy loss per ion pair for alpha-particles in air relative to polonium alpha-particles, w, was obtained as $w = 0.948 + (0.119/\sqrt{E})$, where E is the initial alpha-energy in MeV. This formula is valid at least for alpha-energy down to 1 MeV. A.

## DISCHARGE TUBES. COUNTERS 537.54

537.542

5162. SIMPLIFIED RADIO-FREQUENCY ION SOURCE. S.K.Allison and E.Norbeck, Jr.
Rev. sci. Instrum., Vol. 27, No. 5, 285-8 (May, 1956).

The quartz or glass sheathed cylindrical cathode probe of the conventional r.f. ion source has been eliminated. The conventional glass pad electron beam "back stop" has been replaced by nonfracturing porcelain. Commercial Pyrex pipe has been used in the construction of the glass thimble in which the plasma is formed, and the thimble sealed to the base with O-ring pressure seals. The anode probe is removable for ease in cleaning. The source produces 300 $\mu$A of $H^+$; it also produces 200 $\mu$A of $He^+$, and at low operating gas pressures, usable amounts of $He^{++}$, as large as a few tenths of a % of the $He^+$ output. A.

537.542

5163. NEGATIVE HYDROGEN ION SOURCE. J.A.Weinman and J.R.Cameron.
Rev. sci. Instrum., Vol. 27, No. 5, 288-93 (May, 1956).

A negative hydrogen ion source has been built which will yield from 25 to 30 $\mu$A of $H^-$ ions focused on a $\frac{1}{4}$ inch diameter spot. This is accomplished by first producing positive ions in a magnetic ion source. These ions are extracted and accelerated by at most 17.5 kV. The ions then pass through an electron pickup capillary tube into the centre of which the electron donating gas is introduced. The $H^-$ ions emerging from this tube are accelerated by an additional 20 to 30 kV while the emerging secondary electrons are electrostatically repelled. The negative ions are then focused by an electrostatic "saddle field" lens and magnetically analysed. An Evapor-ion pump is used to maintain the pressure in the ion source container less than $10^{-4}$ mm Hg. A.

537.542 : 541.124

5164. CHEMICAL ASPECTS OF THE GEIGER–MÜLLER DISCHARGE. I. THE ETHANOL–ARGON COUNTER. R.W.Kiser and W.H.Johnston.
J. Amer. Chem. Soc., Vol. 78, No. 4, 707-9 (Feb. 20, 1956).

The decomposition of the ethanol quench gas by the Geiger–Müller discharge in an ethanol–argon counter was investigated mass spectrometrically. The decomposition was first order with a decomposition constant of $8.55 \times 10^{-9}$ per pulse, corresponding to an initial rate of 359 molecules of ethanol destroyed per electron passed. This large effective electron yield suggests the primary mechanism is electron collision in the gas phase. A.

537.542

5165. ON THE SUBJECT OF THE SENSITIVE VOLUME OF EXTERNAL CATHODE GEIGER-MÜLLER COUNTERS. A.M.Baptista and J.P.Galvão.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 647-8 (March, 1956). In French.

Briefly describes the measurement, with a movable source, of the active region of an external (graphite) counter tube. Experimental data are shown. J.D.Craggs

537.542 : 621.387.424

5166. AN OXYGEN-QUENCHED GEIGER-MÜLLER COUNTER. D.Srdoč.
J. sci. Instrum., Vol. 33, No. 5, 185-6 (May, 1956).

Systematic investigations have been made to determine the best concentrations of mixtures of neon, argon and oxygen for filling self-quenching G-M. counters. Evidence is given of the quenching action of oxygen in mixtures with neon and argon. The life of such counters seems to be unlimited. A plateau 65 V wide with a 15% slope per 100 V has been obtained at $V_{op}$ = 400 V. Cathodes of various materials have been used and it was found that copper, brass and aluminium, coated with colloidal graphite, are quite satisfactory. This is an advantage relating to halogen-quenched G.-M. counters. A.

537.542 : 548.733

5167. A PROPORTIONAL COUNTER TUBE FOR X-RAY DIFFRACTION ANALYSIS. A.R.B.Skertchly.
J. sci. Instrum., Vol. 33, No. 6, 209-10 (June, 1956).

An argon-filled, ethyl alcohol quenched counter utilizing a diagonal radiation absorption path is described. The quantum efficiency is 67% when detecting CuK$\alpha$ quanta. When it is used in conjunction with a single-channel pulse amplitude analyser operating with a bandwidth of 3.6 V centred at 30 V its overall efficiency is 46%. Little distortion is introduced into the pulse height distribution curve owing to the incomplete dissipation of the energy of the photoelectrons, and the required low capacitance for high signal-to-noise ratios at low operating potentials is preserved. A.

537.542

5168. PRESSURE REGULATOR FOR A LOW-PRESSURE CONTINUOUS-FLOW IONIZATION CHAMBER. R.A.Lowry, J.E.Osher and G.H.Miller.
Rev. sci. Instrum., Vol. 27, No. 5, 309-10 (May, 1956).

A description is given of an automatic pressure-regulating device for a continuous-flow ionization chamber operated in the pressure range of 1 to 10 mm Hg. The pressure monitor consisted of an oil manometer, a light source, and two phototubes arranged whereby any small change in pressure gave rise to a corresponding electrical signal. This signal was used to control the power to a thermal gas flow valve. The regulator was capable of maintaining the pressure constant to within 0.03 mm Hg for a period of at least 24 hr. A.

537.542 : 539.166.08 : 578.087

5169. THE LOS ALAMOS HUMAN COUNTER. E.C.Anderson, R.L.Schuch, J.D.Perrings and W.H.Langham.
Nucleonics, Vol. 14, No. 1, 26-9 (Jan., 1956).

The counter is of the liquid scintillation type with 140 gal of solution (4 g/l. terphenyl and 0.1 g/l. of POPOP in toluene) contained in a hollow cylindrical tank 72 in. long, 30 in. outside diameter and 18 in. inside diameter. The inside of the tank is coated with anatase $TiO_2$ in an epoxy resin and the liquid is viewed by 108 photomultipliers set in the outer counter wall. A 5 in. thick 20 ton lead shield surrounds the counter which is 10% efficient for $K^{40}$ gamma-radiation from a subject placed inside the cylinder (neglecting self-absorption). The counter background was found to be 440 counts per second. L.R.Shepherd

537.542

5170. LIQUID SCINTILLATORS. II. PULSE-HEIGHT COMPARISON OF SECONDARY SOLUTES. F.N.Hayes, D.G.Ott and V.N.Kerr.
Nucleonics, Vol. 14, No. 1, 42-5 (Jan., 1956).

For Pt I see Abstr. 2964 (1956). Relative pulse heights from a variety of secondary solutes, introduced into scintillation solutions to produce a more easily transmitted and reflected spectrum, were investigated, with p-terphenyl or PPO as primary solutes in toluene. DuMont 6292 photomultipliers were used, with 4.43 MeV and 2.76 MeV gamma-rays, particular attention being given to 4 secondary solutes, viz. POPOP, BBO, $\alpha$NPO and DPH with p-terphenyl. L.R.Shepherd

537.542

5171. RESPONSE FUNCTION OF NaI(Tl) SCINTILLATION COUNTERS. M.J.Berger and J.Doggett.
Rev. sci. Instrum., Vol. 27, No. 5, 269-70 (May, 1956).

The response function for gamma-radiation has been calculated by the Monte Carlo method. Summary results of this calculation are presented in terms of the photofraction, i.e., the ratio of the area under the photopeak to the total area of a scintillation spectrum. Values of the photofraction are given for collimated monoenergetic radiation with energies between 0.279 and 4.45 MeV incident centrally on the endface of cylindrical crystals ranging in size from 0.25 in. (radius) x 0.5 in. (length) to 2.5 x 9 in. A.

537.542

5172. DETECTION OF CHARGED PARTICLES WITH GAS SCINTILLATION COUNTERS. R.A.Nobles.
Rev. sci. Instrum., Vol. 27, No. 5, 280-3 (May, 1956).

A study has been made of the pulse heights obtained from $\alpha$-particles in a gas scintillation counter using argon, krypton and xenon. Measurements were made with an RCA-6342 photomultiplier viewing the scintillations directly and also with the aid of a quaterphenyl wavelength shifter. Pulse heights from xenon were about 10 times as great as those from argon and 3.6 times those from krypton. The gain in pulse height with a wavelength shifter was about a factor of 15 for each gas. The rise time of the light pulses was of the order of one $\mu$sec or less. Pulse height was found to be a linear function of energy for protons, deuterons and helium ions in a xenon counter with a wavelength shifter. The pulse height was independent of the type of particle producing the scintillations and depended only on the energy lost in the counter. A.

537.542

5173. THE ABSOLUTE LUMINESCENCE YIELD OF $\gamma$-SCINTILLATIONS IN NAPHTHALENE AND ANTHRACENE CRYSTALS. M.D.Galanin and A.P.Grishin.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 33-41 (1956). In Russian.

An experimental arrangement calibrated in absolute units has been used to determine the absolute energy yield of $\gamma$-scintillation luminescence due to Compton electrons. In a naphthalene crystal containing 1% anthracene this was found to equal $0.7 \pm 0.2\%$. A.

537.542 : 621.374.32 : 621.375.2

5174. AN INPUT AMPLIFIER FOR A PULSE-HEIGHT ANALYSER. A.Folkierski.

J. sci. Instrum., Vol. 33, No. 5, 187-91 (May, 1956).

The design described incorporates two facilities important in the study of $\gamma$-ray spectra. Firstly, the analyser can be gated by pulses occurring simultaneously with the pulses to be measured. Secondly, the scale can be expanded. Errors introduced by the gate do not exceed 1% of the maximum output pulse-height. A.

537.542 : 621.375.2.018.756

5175. MINIMUM NOISE PRE-AMPLIFIER FOR FAST IONIZATION CHAMBERS. C.Cottini, E.Gatti, G.Giannelli and G.Rozzi.

Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 473-83 (Feb., 1956).

A fast, low-noise, pulse amplifier is described, which has an input stage consisting of a cascode of two triode-connected E83F tubes. Its r.m.s. noise voltage is equivalent to a pulse of 280 electronic charges injected on an input capacitance of 21 pF, the frequency response of the amplifier being defined by two RC circuits having both a time constant of 1.5 $\mu$sec. On a capacitance of 34 pF and a frequency response given by time constants of 3 $\mu$sec the r.m.s. noise is equivalent to a pulse of 380 electronic charges. A.

537.542 : 621.374.32

5176. A SIMPLE THREEFOLD COINCIDENCE CIRCUIT USING ONLY ONE EQ 80 (6 BE 7) VALVE. E.Pohl.

Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 642-4 (March, 1956).

The three control grids of an EQ 80 which are each separated by screen grids, when polarized to maintain the valve normally cut off, serve as inputs for the channel of a triple coincidence. The circuit is completely insensitive to single and double coincidences, and is economical both in valves and current. A.

537.542 : 621.374.33

5177. CALIBRATION APPARATUS FOR TIME SELECTORS. J.Mey and A.Boucherie.

Onde élect., Vol. 35, 990-4 (Nov., 1955). In French.

The apparatus is used for calibrating a neutron time-of-flight selector. It generates pairs of pulses, either at a rate of 900 per second or synchronized to an external source. The interval between the pulses is variable, 1 $\mu$sec at a time from 1 to 999 $\mu$sec. These intervals are referred to a 1 Mc/s crystal oscillator. A complete diagram with all component values is included. S.C.Dunn (R)

537.542 : 539.16.08

IMPROVEMENT OF COINCIDENCE TECHNIQUES APPLIED TO THE (ABSOLUTE) STANDARDIZATION OF RADIOACTIVE INTENSITY (FOR SOURCES OF 5-50$\mu$c). See Abstr. 4599

537.542 : 539.164

5178. APPARENT VELOCITY OF ALPHA-PARTICLES IN CLOUD CHAMBERS. J.A.Prins and S.A.Hempenius.

Nature (London), Vol. 177, 487 (March 10, 1956).

The visual impression that the tracks shoot out from the source in a fraction of a second is attributed to the finite diffusion rate of water vapour to the droplets. The growth of the droplets at the end of the track is slower because of the stronger competition due to the larger density of ionization. J.Hughes

537.542

5179. RECTANGULAR WILSON CHAMBER WITH BILATERAL EXPANSION. V.G.Kirillov-Ugryumov, V.M.Fedorov and B.N.Deryagin.

Zh. éksper. teor. Fiz., Vol. 28, No. 5, 603-7 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 484-7 (Nov., 1955).

A detailed description and diagrams are given of the chamber, designed for use with a magnetic mass spectrometer. J.Hughes

## IONIZATION. THERMIONICS 537.56/58

537.56

5180. THE DIFFUSION OF SLOW ELECTRONS IN DEUTERIUM. B.I.H.Hall.

Austral. J. Phys., Vol. 8, No. 4, 468-73 (Dec., 1955).

The agitational energies and drift velocities of slow electrons diffusing in deuterium are measured as a function of the ratio Z/p of the electric field strength Z to the gas pressure p. The lateral spread of the diffusing electron stream is measured, which enables Townsend's energy coefficient to be calculated. Drift velocities are measured using a magnetic deflection method. On the basis of the kinetic theory of gases these measurements are used to calculate values for the mean free path L of the electrons at unit pressure, the mean proportion $\eta$ of the energy lost by an electron in a collision with a deuterium molecule, and the collisional cross-section A of the molecules in collisions with the electrons. The values obtained are compared with those of Crompton and Sutton (1952) for hydrogen. A.

537.56

5181. THE DETERMINATION OF THE IONIZING FIELD IN SOME SIMPLE SYSTEMS. J.Dupuy.

C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1140-3 (Feb. 27, 1956). In French.

Expressions are given for the ionizing fields (in terms of dimensions, current density, ionic mobility and breakdown field) for the following systems: wire and plane, wire between two planes, grid and parallel plane, grid between two parallel planes. J.Dutton

537.561

5182. CRITICAL IONIZATION POTENTIALS USING A PARALLEL-PLATE ENERGY SELECTOR. D.A.Hutchison.

J. chem. Phys., Vol. 24, No. 3, 628-9 (March, 1956).

The selector, operated for maximum range and focusing, was used in conjunction with an electron-bombardment ion source and a 60° mass spectrometer. With the dimensions used, the optimum resolving power was ~236; energy distribution half-widths were greater than ideal prediction, possibly due to large-angle scattering and secondary emission from grid on electron trap. Ion currents were detected by a vibrating-reed electrometer. Measured data are reported for argon and compared with optically determined values. N.M.King

537.561

5183. APPEARANCE POTENTIAL STUDY OF $CBrF_3$. A.Jacobson, J.Steigman, R.A.Strakna and S.S.Friedland.

J. chem. Phys., Vol. 24, No. 3, 637-8 (March, 1956).

A 90° sector-type spectrometer was adapted so that appearance potentials as well as cracking patterns could be determined. For $CF_3^+$ the appearance potential may be expressed as $D(CF_3{-}Br) + I(CF_3^+) + E$ where D, I refer to dissociation energy and ionization of the radical, E includes excess kinetic and electron excitation energy. J.Jacobs

537.561

5184. IONIZATION POTENTIAL OF PROPYNE. K.Watanabe and T.Namioka.

J. chem. Phys., Vol. 24, No. 4, 915 (April, 1956).

Describes the use of a photo-ionization technique for the measurement of the ionization potential of certain organic vapours (propyne, acetylene and 1-butyne). Numerical results are given. J.D.Craggs

537.561 : 539.132

5185. IONIZATION POTENTIALS OF AMMONIA AND THE EXCITED STATES OF THE $NH_3^+$ ION. C.A.McDowell.

J. chem. Phys., Vol. 24, No. 3, 618 (March, 1956).

The results of recent electron impact experiments suggest that the production of the ion $NH_2^+$ from ammonia may proceed by the dissociation of a vibrationally excited ion $NH_3^+$ in the

first excited electronic state, rather than in the electronic ground state. Decision between these two possibilities is difficult, owing to the distortion of the $NH_3^+$ ion during dissociation, which makes identification of its vibronic state impossible. C.E.King

537.564

5186. CROSS-SECTIONS OF MOLECULES FOR IONIZATION BY ELECTRONS. J.W.Otvos and D.P.Stevenson.
J. Amer. Chem. Soc., Vol. 78, No. 3, 546-51 (Feb. 5, 1956).

It is shown that for a wide variety of substances including hydrocarbons and their substitution derivatives, the total relative ionization cross-sections as measured in ion gauges or mass spectrometers (low pressures and low energy electrons), or by total ion production in gases (at or near atmospheric pressure) by $C^{14}$ or $Sr^{90}$-$Y^{90}$ $\beta$-particles, are a constitutive molecular property. It is further shown that, particularly for ionization by single electron impact and to a lesser degree for total ion production by $\beta$-particles, the atomic ionization cross-sections of the elements are given by the sum of the valence electrons weighted by the mean square radii of those electrons as calculated for hydrogen-like wave-functions for the electrons. A table of calculated atomic ionization cross-sections is given for elements with $1 \leq Z \leq 56$, and $Z = 80, 81$ and 82. The utility of the rules for ionization cross-sections in various analytical applications is described and illustrated. A.

537.564

5187. MODEL FOR COLLISION PROCESSES IN GASES: SMALL-AMPLITUDE OSCILLATIONS OF CHARGED TWO-COMPONENT SYSTEMS. E.P.Gross and M.Krook.
Phys. Rev., Vol. 102, No. 3, 593-604 (May 1, 1956).

The general features of the small-amplitude oscillations of a two-component ionized gas are discussed. The effects of the random thermal motions of ions and electrons are described by one-particle distribution functions. When collisions are neglected, there are two types of waves for a given wavelength. One is a high-frequency electron plasma oscillation, slightly modified by ionic motions. The other is the Tonks–Langmuir positive-ion oscillation which is shown to be undamped when the electron temperature is considerably greater than the ion temperature. The effects of collisions are treated by a kinetic model which satisfies the conservation laws, and provides for energy and momentum exchange between components. The low-pressure waves are damped primarily because of the decreasing electron temperature with increasing collision frequency. The validity of transport treatments is investigated. At high density and high frequency one finds the correct sound wave for a mixture of gases. Study of the frequency as a series of inverse powers of the collision frequency shows that the first-power term yields absorption independent of the electric charge. Higher powers give contributions to the absorption and dispersion which depend on electrical polarization as well as on diffusion, viscosity and heat conductivity. The behaviour at the more frequently realized case of low frequency and high pressure depends on the electric charge more directly. A.

537.582 : 541.183

5188. EFFECT OF AN ADSORBED FILM OF DIPOLE MOLECULES ON THE ELECTRON WORK FUNCTION.
N.D.Morgulis and V.M.Gavrilyuk.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 149-59 (1956). In Russian.

Changes in the work function of tungsten have been studied under conditions of high vacuum when an accurately dosed film of varying thickness of caesium chloride molecules is precipitated on the metal; a fraction of the caesium atoms consisted of radioactive $Cs^{134}$ which permitted the density of the molecules in the film to be determined with a sufficient degree of accuracy by its activity. It is shown that films of CsCl molecules possessing intrinsic dipole moments decrease the work function of tungsten; this decrease, however, is much smaller than that observed in the caesium atom film. These systems are compared with the data cited in the literature for BaO-W and Ba-W systems. Some possibilities of theoretical interpretation of the results obtained are discussed A.

537.583

5189. THERMIONIC EMISSION OF SINTERED MIXTURES OF POWDERED TUNGSTEN AND ALKALINE EARTH CARBONATES. G.Mesnard and R.Uzan.
Vide, Vol. 10, 105-18 (July-Sept., 1955). In French.

A study of the behaviour of cathodes sintered from W powder and $(BaSr)CO_3$ with various additives, e.g. Ni and C. In nearly all cases the emissions observed were very small and in the best case, using a composition very close to that used by Hughes and Coppola, (Abstr. 296/1953) the emission was considerably less than the values earlier reported. The authors suggest that this may be due to the use of smaller pores or higher pressure. A.H.W.Beck

537.583

5190. SINTERED CATHODES OF ALKALINE EARTH OXIDES CONTAINING ZIRCONIUM. G.Mesnard and R.Uzan.
Vide, Vol. 10, 124-34 (July-Sept., 1955). In French.

Sintered cathodes using either Ni or W as matrix materia and zirconium as reducing agent were studied. Two proportions of Zr were used, 1 : 1 molecular ratio to $(BaSr)CO_3$ and 1 : 10 molecular ratio. Best results were obtained with the smaller amount of Zr but even in this case the emissions were so low by comparison with the results reported elsewhere that it seems doubtful whether the test cathodes were properly activated. A.H.W.Beck

537.585

5191. ON THE POSITIVE ION EMISSION FROM HOT PLATINUM IN VARIOUS GASES. Y.Koike and T.Shibata.
J. Inst. Elect. Engrs Japan, Vol. 75, 260-4 (March, 1955). In Japanese.

In a study of ion emission from hot Pt, where an excessive amount of air containing a small quantity of organic halide gas was observed, it was noted that the emission showed a max. value at $\sim 1050^\circ$C and a min. at $\sim 1300^\circ$C. From experimental results on hot Pt emission in various gases (e.g. HCl; a mixture of air and $CCl_4$ or $CHCl_3$; a mixture of O or N with $CCl_4$ or other gases) the conclusions are reached that: (1) the abrupt increase at $\sim 1050^\circ$C is due to the reaction of the carbon in the organic chloride and the oxygen in the air resulting in the formation of $CO_2$; (2) the min. at $\sim 1300^\circ$C is due to CO predominating over $CO_2$. H.G.M.Spratt

## COSMIC RAYS 537.591

537.591.1

5192. OBSERVATIONS ON THE MULTIPLY CHARGED PARTICLES OF THE COSMIC RADIATION. C.J.Waddington.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 930-55 (May, 1956).

A nuclear emulsion technique has been used to measure the fluxes of the $\alpha$-particles of the primary cosmic radiation at three different geographical positions. Two of these determinations were made on the same geomagnetic latitude, one over America, which has been previously reported, and the other over England. The two flux values found were unexpectedly significantly different, and this difference could be entirely attributed to the absence over England of those $\alpha$-particles with energies of less than about 0.65 GeV per nucleon. Measurements on the protons and heavy primary particles detected in those two stacks of emulsions also indicated that the cut-off energy over England at the time of the expos-

ure was between 0.60 and 0.70 GeV per nucleon, instead of the 0.33 GeV per nucleon calculated from the known geomagnetic latitude. Similarly, the data from the American stack suggest that when this was exposed the cut-off energy was less than 0.15 GeV per nucleon. An analysis has been made of the various experimental flux values obtained at different points on the earth's surface, and it is concluded that the cut-off energies should be calculated, not from the geomagnetic latitudes, but from latitudes which are from four to six degrees lower over Europe, and three or more degrees higher over America. A.

537.591.1

5193. ON THE PROBLEM OF ANTI-PROTONS IN THE PRIMARY STREAM OF COSMIC RAYS. M.I.Fradkin.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 147-50 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 87-9 (Jan., 1956).

Analysis of data on the east-west asymmetry of cosmic rays at high altitudes demonstrates that it is impermissible to exclude the possibility of the presence of a certain proportion (up to 13%) of negatively charged particles in the primary radiation. Computation shows that in the primary radiation the proportion of anti-protons formed in interstellar space cannot exceed 0.2% and apparently the presence of anti-protons cannot explain the results of measurement of east-west asymmetry. A.

537.591.1

5194. MESON COMPONENT OF THE COSMIC RADIATION AT AN ALTITUDE OF 3200 m ABOVE SEA LEVEL.
I.M.Kocharyan, M.T.Aĭvazyan, Z.A.Kirakosyan and A.S.Aleksanyan.
Zh. éksper. teor. Fiz, Vol. 30, No. 2, 243-7 (1956). In Russian.

The $\mu$-meson momentum spectrum in the momentum range $0.4 \leq p \leq 14$ BeV/c has been measured at an altitude of 3200 m above sea level. The ratio between the numbers of protons and $\mu$-mesons at this height has been determined. The momentum dependence of the ratio between the numbers of positive and negative $\mu$-mesons has also been determined. A.

537.591.1 : 778.34

5195. INVESTIGATION OF THE "ASSOCIATED STAR" EFFECT BY MEANS OF MOVING PHOTOGRAPHIC PLATES.
I.M.Gramenitskiĭ, M.I.Podgoretskiĭ and Yu.F.Sharapova.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 277-81 (1956). In Russian.

The moving photographic plate method was used to study the problem of simultaneity of formation of "associated stars" in nuclear tracks. It is shown that the so-called "associated stars" are formed at various times. A.

537.591.1 : 539.18

HEAVY UNSTABLE PARTICLES IN COSMIC RADIATION.
See Abstr. 4657

537.591.15

5196. A HIGH ENERGY SHOWER. A.Debenedetti, C.M.Garelli, L.Tallone, M.Vigone and G.Wataghin.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 226-7 (Jan., 1956).

A possible anomaly with respect to cascade theory is reported to have been observed in an emulsion event obtained during the Sardinia expedition. The mean free path for trident production deduced from the shower seems to be two or three times smaller than predicted on the basis of Bhabha's theory. E.W.Kellermann

537.591.5 : 523.72

5197. ANOMALOUS INTENSITY INCREASE OBSERVED AT SACLAY ON FEBRUARY 23RD, 1956. G.Delibrias and M.T.Perquis.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1722-4 (March 26, 1956). In French.

This has been observed by means of an assembly of 36 G.M. nickel sheathed counters in parallel, of area 25 x 500 mm, shielded on all sides by 20 cm Pb. From the average integral counts per hour of 78 000, counts rose to 111 000 on this day between 3.30 and 4.30 hr. G.M.T., and descended to 96 000, 80 400 and 79 000 respectively during the three following hourly intervals. Fluctuations had already been observed on February 18th, the hourly counts between 1 and 4.30 hr. G.M.T. being 87 600, and between 20 and 21 hr. G.M.T. 87 000. E.W.Kellermann

537.591.5

5198. THE "N" COMPONENT OF COSMIC RAYS IN RELATION TO OSCILLATIONS OF THE ATMOSPHERE.
P.Bassi and F.Ferrari.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 806-14 (April, 1956).

Acting on the suggestion implicit in some recent experimental results, Heisenberg's theory has been used to calculate the correlation between oscillations of the earth's atmosphere and the intensity of the N component of cosmic-rays. The theoretical predictions are in qualitative but not in quantitative agreement with the experimental results. However these latter are, at present, statistically poor. A.

537.591.5 : 523.75

5199. THE INCREASE IN THE TOTAL COSMIC RAY INTENSITY AND IN THE POSITIVE EXCESS DUE TO THE SOLAR FLARE OF 23rd FEBRUARY 1956. I.Filosofo, I.Modena, E.Pohl and J.Pohl-Rüling.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1112-18 (May, 1956).

Increases have been detected which were clearly associated with the large solar flare of the 23 Feb., 1956. The differential and integral spectra for the additional $\mu$-mesons produced in the atmosphere have been derived. The nature of the positive excess of these mesons leads to the conclusion that the particles coming from the flare were mainly protons. Their energy is estimated to lie between 4 and 10 GeV. In this band the primary flux increased to about 25 times normal during the flare. A.

537.591.5

5200. THE DAILY VARIATION OF THE COSMIC RAY INTENSITY MEASURED NEAR THE 1954 SUNSPOT MINIMUM.
M.Possener and I.J.van Heerden.
Phil. Mag.(Ser. 8), Vol. 1, No. 3, 253-60 (March, 1956).

The solar daily variation of the ionizing component of cosmic radiation has been measured at sea-level by means of unshielded counter telescopes pointing in the north and south directions at a zenith angle of $45^0$ during the years 1948, 1951, 1952, 1953 and 1954. The amplitude of the daily variation has decreased steadily over these years. For several months during 1953 and 1954, the variation showed an anomolous change in phase, the time of maximum intensity occurring during the night. During these months, the amplitude of the daily variation of the nucleonic component of cosmic radiation was found to decrease to a value not significantly different from zero. A.

537.591.5

5201. THE EFFECT OF LUNAR-TIDAL OSCILLATION OF THE ATMOSPHERE ON THE INTENSITY OF THE HARD COMPONENT OF COSMIC RAYS. A.I.Kuz'min and G.V.Skripin.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 608-9 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 556-7 (Nov., 1955).

The semidiurnal variation $\delta I$ ($\sim 0.05\%$) was found to depend strongly on the phase difference of the solar and lunar days. Averaging over periods separated by 14.3 solar days revealed an approximately 10-fold variation of $\delta I$ plotted as a function of phase difference. The lunar-tidal pressure wave (0.08 mb) alone can only account for 20% of this effect. It is necessary to assume that the main effect is through the vertical redistribution of the atmosphere. R.H.W.Johnston

537.591.5

5202. VARIATION OF THE GLOBAL INTENSITY OF THE HARD COMPONENT OF COSMIC RAYS DURING THE PASSAGE OF AIR MASS FRONTS. D.D.Krasil'nikov.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 610-13 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 557-60 (Nov., 1955).

The total intensity I of the hard component of cosmic rays (C.R.) was measured near sea level to within about 0.3% per hour. Variations $\delta I_h$ and $\delta I$ with and without barometric correction (−0.14% per mb) are shown plotted as a function of time for four types of front. In contrast to earlier work (Phys. Rev., Vol. 58, 583-5, Oct. 1, 1940) allowance was made for geometric effects, diurnal C.R. variations and variations of front velocity. Variations associated with the upper boundaries of fronts, points of occlusion and regions of increasing or decreasing pressure may be of meteorological interest and require further study. It is pointed out that in C.R. work, when temperature profile data are not avoidable, meteorological effects cannot be excluded without a more detailed classification of the meteorological processes. It is suggested that $\delta I_h$ may provide temperature profile information for the upper atmosphere. R.H.W.Johnston

537.591.8

5203. PRODUCTION OF COSMIC RAY MESONS AT LARGE ZENITH ANGLES. D.Jakeman.
Canad. J. Phys., Vol. 34, No. 5, 432-50 (May, 1956).

Events have been selected by coincidences between separated shielded trays of Geiger counters and it is shown that they arise from three types of phenomena, namely, extensive air showers, casual coincidences, and particles travelling in almost a horizontal direction. Selection of the last type of event has enabled the absolute intensity to be determined at zenith angles between $88^0$ and $90^0$. Using a $\pi$-meson production spectrum which gives consistency with the established underground absorption curve the intensity of particles in the horizontal direction has been calculated on the assumption that $\pi$-$\mu$ decay is the only source of $\mu$-mesons. The calculated intensity agrees well with the observations. Alternatively, by comparing the rate in the horizontal direction with the known rate underground, a value of $4.5 \pm 1.5 \times 10^{-8}$ sec is obtained for the lifetime of the parents of $\mu$-mesons which, because of the depth of the atmosphere in the horizontal direction (362 m.w.e.), must have energy exceeding $10^{11}$ eV. This suggests that at this energy the parents of $\mu$-mesons can be identified with the $\pi$-meson, and the number of $\mu$-mesons arising from the decay of a shorter lived meson (e.g. K meson) must be relatively small. A.

## MAGNETISM 538

538.113

5204. NOTE ON THE PARAMAGNETIC SUSCEPTIBILITY AND THE GYROMAGNETIC RATIO IN METALS. R.Kubo and Y.Obata.
J. Phys. Soc. Japan, Vol. 11, No. 5, 547-50 (May, 1956).

Although the orbital magnetic moments of the electrons in metals are "quenched" by the crystal field, their contribution to the paramagnetic susceptibility for partly filled degenerate bands is shown to be of the same order of magnitude as the Pauli spin paramagnetism. This contribution corresponds to the so-called "temperature independent high frequency term" in the theory of the paramagnetic susceptibility of atoms. Due to this contribution, the gyromagnetic ratio is reduced by an appreciable amount. A.

538.114

5205. FERRO- AND FERRIMAGNETISM, A PROPOSED NOMENCLATURE. J.C.De Bremaecker.
Amer. J. Phys., Vol. 24, No. 5, 414 (May, 1956).

538.114

5206. FERROMAGNETIC RELAXATION AND GYROMAGNETIC ANOMALIES IN METALS. C.Kittel and A.H.Mitchell.
Phys. Rev., Vol. 101, No. 5, 1611-12 (March 1, 1956).

It is suggested that the 3d ion cores and 4s electrons in ferromagnetic metals interact. This effect is shown to lead to an additional internal field $H_i$ acting on the magnetization due to the 3d electrons and proportional to the 3d-4s interaction energy A and the magnetization of the 4s electrons $M_S$. With $H_i$ about 300 oersted, the frequency dependence of the g factor can be understood and the formula $g-2 = 2-g'$ is more nearly obeyed. The relaxation time for ferromagnetic resonance is also calculated and is in agreement with observation. The value of A is only about 1% of the free atom value, due to screening by the 3d electrons, and the value of $M_S$ is only about 1 gauss so that the s electron magnetization is itself negligibly small. E.P.Wohlfarth

538.114 : 539.11

5207. ORDERING AND ANTIFERROMAGNETISM IN FERRITES. P.W.Anderson.
Phys. Rev., Vol. 102, No. 4, 1008-13 (May 15, 1956).

The octahedral sites in the spinel structure form one of the anomalous lattices in which it is possible to achieve essentially perfect short-range order while maintaining a finite entropy. In such a lattice nearest-neighbour forces alone can never lead to long-range order, while calculations indicate that even the long-range Coulomb forces are only 5% effective in creating long-range order. This is shown to have many possible consequences both for antiferromagnetism in "normal" ferrites and for ordering in "inverse" ferrites. A.

538.114 : 539.219

5208. SUPEREXCHANGE INTERACTIONS AND MAGNETIC LATTICES OF THE RHOMBOHEDRAL SESQUIOXIDES OF THE TRANSITION ELEMENTS AND THEIR SOLID SOLUTIONS. Y.-Y.Li.
Phys. Rev., Vol. 102, No. 4, 1015-20 (May 15, 1956).

A semiempirical analysis of the superexchange interactions responsible for the formation of the magnetic lattices in $Cr_2O_3$ and $\alpha$-$Fe_2O_3$ is given. The difference between the two magnetic lattices is attributed to the fact that $Cr^{+3}$ has a less-than-half-full d-shell and $Fe^{+3}$ a half-filled d-shell. It is predicted that the $Cr_2O_3$-type magnetic lattice should be found in $V_2O_3$, $Ti_2O_3$ and $TiFeO_3$. One of the superchange interactions in the sesquioxides is compared with the A—B interaction in magnetic spinels. The magnetic phase-diagrams of the systems $Fe_2O_3$—$Cr_2O_3$ and $TiFeO_3$—$Fe_2O_3$ are tentatively outlined from theoretical considerations. A ferrimagnetic structure is proposed for the crystals of the composition $Ti_{2/3}Fe_{4/3}O_3$ which are found in nature and are conspicuously related to certain problems in rock-magnetism. The predictions derived from this semiempirical analysis should be tested by neutron diffraction experiments and magnetic measurements. The experiments of Forestier and of Pouillard on the $Fe_2O_3$—$Cr_2O_3$ system are discussed. A.

538.114

5209. TRANSITIONS AND PHASE DIAGRAMS IN AN ORTHORHOMBIC ANTIFERROMAGNETIC CRYSTAL. C.J.Gorter and T.van Peski-Tinbergen.
Physica, Vol. 22, No. 4, 273-87 (April, 1956).

Néel's molecular field model is applied to an orthorhombic antiferromagnetic crystal and its magnetic and thermal behaviour is analysed. Special attention is given to the case where the external field is applied in the direction preferred for antiferromagnetic alignment. The transitions between the different antiferromagnetic states are considered as well as those to the paramagnetic state. A.

538.114

5210. CONSTANT COUPLING APPROXIMATION FOR HEISENBERG FERROMAGNETISM. P.W.Kasteleijn and J.van Kranendonk.

Physica, Vol. 22, No. 4, 317-37 (April, 1956).

A general expression is derived for the partition function of a Heisenberg ferromagnetic spin system with isotropic coupling between nearest neighbouring spins, in terms of a pair density matrix of a pair of nearest neighbouring spins. With the help of this pair density matrix an effective Hamiltonian $H_e$ for a pair of spins is introduced, and it is shown that $H_e$ contains only an isotropic coupling term of the Heisenberg type, an anisotropic coupling term of the Ising type, and a term representing an effective field acting on the two spins of the pair. The familiar molecular field approximation is obtained by assuming that the two coupling terms in $H_e$ are zero. By minimizing the free energy, it follows that the effective field occurring in $H_e$ is then equal to the Weiss molecular field. A next approximation is obtained by assuming that the effective isotropic coupling in $H_e$ is equal to the actual coupling between the spins, and that the effective anisotropic coupling is zero, which is shown to correspond to the limiting behaviour of $H_e$ for high temperatures. This "constant coupling" approximation constitutes a straightforward generalization of the quasi-chemical method for an Ising spin system to the case of Heisenberg coupling. The thermodynamic properties of the spin system, and in particular the critical data, are calculated on the basis of this constant coupling approximation, and numerical results are given for lattices with coordination number 6, 8 and 12. The theory is compared to the cluster method of P.R.Weiss, and it is shown that in the present theory the difficulty of an anti-Curie point does not occur, so that the constant coupling approximation gives useful results at all temperatures. A.

538.122

5211. GENERAL CONDITIONS WHICH MUST BE SATISFIED BY A SEARCH COIL IN ORDER TO MEASURE AN ARBITRARY MAGNETIC FIELD AT A POINT TO FOURTH-ORDER ACCURACY. P.Gautier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1707-10 (March 26, 1956). In French.

It is shown theoretically that a search coil may be used to measure the magnetic field at a point to fourth-order accuracy, provided it has three perpendicular planes of symmetry through the point, and the turns have an axis of fourth-order symmetry.
A.E.I. Research Laboratory

538.213

5212. NOMOGRAM OF THE FUNCTION $2J_1(z)/zJ_0(z)$ FOR THE STUDY OF THE INITIAL COMPLEX PERMEABILITY OF CIRCULAR CONDUCTORS AT HIGH FREQUENCIES. J.Benoit and E.Naschke.
J. Phys. Radium, Vol. 17, No. 1, 77-8 (Jan., 1956). In French.

The formula for the impedance of a circular conductor is given. A graphical method, based on this, is described for calculating permeability rapidly. L.S.Goddard

538.22

5213. METAMAGNETISM AND MAGNETIC PROPERTIES OF $MnAu_2$. L.Néel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1549-54 (March 19, 1956). In French.

Considers the effect of magnetocrystalline anisotropy of antiferromagnetic substances whose exchange forces are assumed to be much larger for each sublattice than between sublattices. The field dependence of the magnetization is determined for a range of parameter values, and experimental results for $MCl_2$(M = Cu, Ni, Co, Fe) and $MnAu_2$ (Abstr. 1988, 2871/1955) are interpreted. E.P.Wohlfarth

538.22

5214. INTERPRETATION OF THE MAGNETIC PROPERTIES OF DYSPROSIUM AND ERBIUM. L.Néel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1824-8 (April 9, 1956). In French.

The properties of Dy and Er at low temperatures are interpreted as arising from a transition from a ferromagnetic to an antiferromagnetic state caused by the temperature variation of the magnetocrystalline anisotropy coefficient. See also preceding abstract. E.P.Wohlfarth

538.22 : 538.63

5215. A NEW EFFECT IN THE MAGNETORESISTANCE OF ALUMINIUM. B.Lüthi and J.L.Olsen.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 840-1 (April, 1956).

For two polycrystalline Al specimens it was found that $\Delta\rho/\rho$ increases rapidly when $H/\rho > 2nec/10$; this result is at variance with the high field saturation usually observed. The measurements were carried out at 4°K in transverse fields up to $2 \times 10^5$ oersted. E.P.Wohlfarth

538.221

5216. FERROMAGNETIC DOMAINS ON MANGANESE–BISMUTH AT LOW TEMPERATURES. W.Andrä.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 78-83 (1956). In German.

Reports results of domain observations using the magneto-optic Kerr effect. Changes of the patterns with changing temperature are a result of the temperature variation of the magnetocrystalline anistropy coefficient, which vanishes at 90°K, and of the saturation magnetization. E.P.Wohlfarth

538.221

5217. MAGNETIC POWDER PATTERNS ON COBALT AT HIGHER TEMPERATURES (PRELIMINARY COMMUNICATION). W.Andrä.
Ann. Phys. (Leipzig), Vol. 17, No. 4-5, 233-5 (1956). In German.

Reports results of domain observations using colloidal suspensions which remain stable on heating up to 400°C. Temperature changes of the patterns are a result of the variation of the magnetocrystalline anisotropy coefficient, which vanishes at 250°C. E.P.Wohlfarth

538.221

5218. FERRITES IN RESONANT CAVITIES. R.A.Waldron.
Brit. J. appl. Phys., Vol. 7, No. 3, 114 (March, 1956).

It is shown that the usual formula for the frequency shift on introducing a sphere of ferrite into a resonant cavity leads to an incorrect value of the applied field for ferromagnetic resonance. The discrepancy is due to assuming that the field in the ferrite is approximately equal to the unperturbed field. Using the calculated value of the field in the ferrite leads to a formula which agrees with observations. A.E.De Barr

538.221

5219. ON THE MEASUREMENT OF THE MAGNETIC PERMEABILITY OF METALS BY MEANS OF A CAVITY RESONATOR AND THE PERMEABILITY OF IRON IN THE REGION OF FERROMAGNETIC RESONANCE. III. K.H.Reich.
Frequenz, Vol. 10, No. 1, 11-19 (Jan., 1956). In German.

For Pt II see Abstr. 2237 (1956). Results of measurements of the permeability, as a function of applied field, of pure iron, commercial sheet iron, and silicon-iron sheet, at a wavelength of 1.222 cm and at 20°C and 200°C. The measurements were made before and after polishing the specimens. The permeabilities were found to be independent of temperature in the region investigated, and also of the degree of purity of the specimen, but strongly dependent on the roughness of the surface of the specimen, and of the degree of crystal orientation. For an oriented silicon-iron sheet the field strength for resonance was found to vary with the direction of measurement. The results are discussed and compared with theory. A.E.De Barr

538.221

5220. FERROMAGNETIC RESONANCE ABSORPTION IN A PYRRHOTITE SINGLE CRYSTAL. T.Fujimura and Y.Torizuka.
J. Phys. Soc. Japan, Vol. 11, No. 3, 327 (March, 1956).

Reports room temp. measurements at 47 kMc/s parallel to the easy axis of magnetization and in fields up to $2 \times 10^4$

oersted. A very broad resonance line (half-width about $10^4$ oersted) was observed. The anisotropy field deduced from the measurements has a value $6.6 \times 10^4$ oersted.

E.P.Wohlfarth

538.221

5221. NOTE ON THE FERROMAGNETISM OF CoTe. E.Uchida.
J. Phys. Soc. Japan, Vol. 11, No. 4, 465-6 (April, 1956).

A continuation of Abstr. 8073 (1955). Reports results of magnetization measurements up to 1200°C for powdered samples of $CoTe_x$ ($0 \leq x \leq 1.2$), and deduces that these substances are two-phase, Co + $CoTe_{1.2}$. X-ray measurements show that $CoTe_{1.2}$ has the NiAs structure, with a = 3.88 A, c = 5.37 A. E.P.Wohlfarth

538.221

5222. MAGNETIC AFTER-EFFECT IN $Ni_3Mn$ ALLOY. T.Taoka.
J. Phys. Soc. Japan, Vol. 11, No. 5, 537-47 (May, 1956).

The after-effect (i) is large at the intermediate state of order of the alloy, (ii) is most noticeable at the steepest part of the magnetization curve, (iii) is comparatively temperature insensitive, and (iv) is not affected by mechanical deformation. The experimental formula of the phenomenon is well expressed by an analytical form derived by Street and Woolley on the basis of the concept of a thermal activation process of single domain particles. It has been confirmed by electron microscopic study that the alloy is composed of a very large number of small particles of prolate ellipsoidal form embedded in a matrix. The dimension of these particles is of the order of magnitude occupied by only a single magnetic domain. A.

538.221

5223. STUDY OF MAGNETIC ANNEALING ON $Ni_3Fe$ SINGLE CRYSTAL. S.Chikazumi.
J. Phys. Soc. Japan, Vol. 11, No. 5, 551-8 (May, 1956).

Magnetic anisotropy induced by magnetic annealing was measured for a $Ni_3Fe$ single crystal by means of a high-temperature-torque magnetometer. It was found that the magnitude of anisotropy depends upon the crystallographic direction of the field which is applied during annealing. It was largest for ⟨111⟩, next for ⟨110⟩ and smallest for ⟨100⟩. It was also found that the minimum of the anisotropy energy lies not in exactly the same direction as that of annealing field, but in the direction nearer to the neighbouring ⟨111⟩. These facts could be explained qualitatively by Néel–Taniguchi–Yamamoto's formula. Quantitative discrepancy between them could be attributed to the characteristic of a face-centred cubic lattice that some of the nearest neighbours of one atom are also nearest neighbours of one another. The influence of ordinary order was also investigated. A.

538.221 : 548.7

5224. INTRADOMAIN MAGNETIC SATURATION AND MAGNETIC STRUCTURE OF $\gamma$-$Fe_2O_3$. W.E.Henry and M.J.Boehm.
Phys. Rev., Vol. 101, No. 4, 1253-4 (Feb. 15, 1956).

The average moment was found to be 1.18 Bohr magnetons per iron atom, which supports a preferential distribution of iron vacancies on octahedral sites in a spinel structure. A sample motion ballistic method was used for direct measurement of magnetic moments. A.

538.221 : 548.74

5225. NEUTRON DIFFRACTION OBSERVATION OF HEAT TREATMENT IN COBALT FERRITE. E.Prince.
Phys. Rev., Vol. 102, No. 3, 674-6 (May 1, 1956).

The effect on cobalt ferrite of heat treatment in a magnetic field has been studied by neutron diffraction. The data indicate that the magnetic moments are, in general, displaced from the directions which would be expected from consideration of crystalline anisotropy alone. The effect is greater in ferrites that are iron-rich than it is in stoichiometric ferrites The results are consistent with magnetic data. A

538.221

5226. ANTIFERROMAGNETISM IN A $Cr_2O_3$ CRYSTAL. T.R.McGuire, E.J.Scott and F.H.Grannis.
Phys. Rev., Vol. 102, No. 4, 1000-3 (May 15, 1956).

A $Cr_2O_3$ single crystal was grown by the flame fusion method. It has rhombohedral symmetry and showed an antiferromagnetic Curie temperature ($T_C$) of 307°K. Below $T_C$ the the magnetic susceptibility $\chi$ perpendicular to the [111] direction is almost independent of temperature while the value of $\chi$ parallel to [111] approaches zero at very low temperatures. According to the Van Vleck theory, this behaviour indicates that the spins are aligned along [111]. Above 77°K the parallel susceptibility was found to be proportional to the $\frac{3}{2}$ power of the temperature. Resonance measurements (23 500 Mc/s) at the Curie temperature showed a shift in the peak of the absorption curve as a function of temperature. This shift was towards lower magnetic fields, and exhibited an anisotropy effect depending on the direction of the magnetic field which is in agreement with theory. From the temperature dependence of the resonance absorption and the Kittel theory of antiferromagnetic resonance, an estimate of the anisotropy constant and its temperature dependence can be made. A.

538.221

5227. TRANSIENT PHENOMENA IN A FERRITE. S.Matz.
Rev. gén. Elect., Vol. 64, No. 10, 491-509 (Oct., 1955). In French.

Apparatus is described for the simultaneous measurement of rapid variations in the two components of the complex permeability in a high-frequency (850 kc/s) magnetic field. This apparatus has been used to study transient phenomena in a NiZn ferrite as a function of temperature, field strength and time elapsed between the last demagnetization and the establishment of the field. In very weak fields there is disaccommodation of the complex permeability after demagnetization, the time constant varying from several days at liquid N temperature to about one minute at room temperature, suggesting an activation energy of about $10^4$ calories per mole. In larger fields there is, in general, an initial increase in the two components of permeability followed by the decrease. The results are in agreement with the theory of "trainage" discussed by Néel. A.E.De Barr

538.221

5228. INVESTIGATION OF THE MAGNETIC SPECTRA OF SOLID SOLUTIONS OF SOME NiZn FERRITES IN THE RADIO-FREQUENCY RANGE. L.A.Fomenko.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 18-29 (1956). In Russian.

Results of investigation of magnetic spectra of NiZn ferrites with initial permeability values $\mu_a = 200$, 400 and 2000 in the frequency range 0.2-60 Mc/s are presented. The method of measurement of the spectrum and of avoiding possible errors is discussed. The samples were investigated in the absolute zero state, in the residual magnetization state and at various field strengths of the constant magnetizing field. It is shown that the ferrite spectra are of a resonance or relaxation nature and are practically independent of the core dimensions; they can be explained by dispersion of the ferromagnetic substance; this dispersion for ferrites with $\mu_a \cong 2000$ is probably due to the inertia of the effective boundary mass, and for ferrites with $\mu_a \cong 200$ to precession of the magnetization vector in the effective anisotropy field of the ferrite substance. A.

538.222

5229. $\Delta M = \pm 3$ TRANSITIONS IN DILUTE GADOLINIUM ETHYL SULPHATE. H.A.Buckmaster.
Canad. J. Phys., Vol. 34, No. 3, 341-2 (March, 1956).

538.222

30. MAGNETIC SUSCEPTIBILITY OF PLUTONIUM XAFLUORIDE. D.M.Gruen, J.G.Malm and B.Weinstock.
chem. Phys., Vol. 24, No. 4, 905-6 (April, 1956).

After correction for the magnetic susceptibility of the $F_4$ in the sample formed by decomposition, the low observed $\chi_M$ values of $PuF_6$, determined at 81° and 295° K, indicate that the ground electronic state of the molecule is non-generate. G.I.W.Llewelyn

538.222 : 539.4.016.2

31. MAGNETIC ANISOTROPY AND COLD WORKED EXTURE OF TITANIUM. J.Reekie and Y.L.Yao.
roc. Phys. Soc. B, Vol. 69, Pt 4, 417-31 (April, 1956).

Magnetic susceptibility determinations have been made r commercially pure titanium metal following various echanical and thermal treatments. Making use of the known xture of heavily rolled titanium, values have been deduced r the principal susceptibilities and magnetic anisotropy of e hexagonal metallic lattice. The values obtained are: $= 3.34_0 \times 10^{-6}$ and $\chi_\perp = 3.08_7 \times 10^{-6}$ e.m.u.g$^{-1}$ at 25° C. These gures have been confirmed by preliminary measurements an oriented single crystal of titanium. Knowing the magtic anisotropy it is possible to estimate the texture in a ecimen of the cold worked or annealed metal from susceptility measurements made in three orthogonal directions. his has been done in a number of cases, and the practical se of this aspect of the work is discussed. It is shown from agnetic measurements that heavily compressed titanium as a texture in which the basal planes of the hexagonal lattice e normal to the compression direction. Assuming that a mpressed specimen approximates magnetically to single ystal behaviour, the temperature variations of the principal sceptibilities have been determined from 25° C to 300° C. he magnetic anisotropy is found to be temperature independent over this range, and the temperature coefficient of susptibility, $d\chi/dT$, is $0.0011 \times 10^{-6}$ e.m.u.g$^{-1}$deg$^{-1}$. A.

538.222

232. PARAMAGNETIC ELECTRON RESONANCE.
.Berthet.
ahiers de Phys., No. 67, 6-18 (March, 1956). In French.

A general review.

538.222

233. PARAMAGNETIC RESONANCE SPECTRA FROM INGLE CRYSTALS OF HEMOGLOBIN DERIVATIVES.
.George, J.E.Bennett and D.J.E.Ingram.
chem. Phys., Vol. 24, No. 3, 627-8 (March, 1956).

The paramagnetic electron resonance of single crystals f acid ferrimyoglobin give $g_{\parallel} = 2.00 \pm 0.01$ and $g_\perp = 6.00 \pm .05$ with respect to the normal to the plane of the haem. $g_\perp$ emains 6.00 at 6 mm which indicates the S = 5/2 ionic ground tate to be split with $S_Z = \pm 1/2$ doublet lying at least 2 cm$^{-1}$ elow the higher states. D.H.Whiffen

538.222 : 539.132

234. ELECTRON DENSITIES IN SEMIQUINONES BY ARAMAGNETIC RESONANCE. H.M.McConnell.
. chem. Phys., Vol. 24, No. 3, 632 (March, 1956).

Suggests that the proton coupling coefficient for the j th ydrogen atom in an aromatic free radical = $34\rho_j$ gauss where $\rho_j$ is the unpaired electron density on the j th carbon atom. aramagnetic electron resonance fine structures for ortho nd para semiquinones are in agreement with this. D.H.Whiffen

538.222

235. PARAMAGNETIC RESONANCE ABSORPTION OF $Mn^{++}$ IN SINGLE CRYSTALS OF $CaCO_3$. H.M.McConnell.
. chem. Phys., Vol. 24, No. 4, 904-5 (April, 1956).

An interpretation of the spectrum observed previously Abstr. 4724/1954) in terms of an axial and a weak cubic crytal field and hyperfine interactions. D.H.Whiffen

538.222 : 532.73

5236. PROTON SPIN RELAXATION IN WATER-GLYCERIN SOLUTIONS OF CHROMIUM (III) IONS. L.O.Morgan, J.Murphy and A.W.Nolle.
J. chem. Phys., Vol. 24, No. 4, 906-7 (April, 1956).

The proton spin relaxation times $T_1$ and $T_2$ were both measured for $H_2O$/glycerine mixtures containing $Cr^{+++}$ ions and the CH protons shown to relax with $T_1$ = 51 msec; the OH protons, which exchange between the glycerine, water and hydrated Cr ion, have $T_1$ = 12 msec for a 65.5% glycerine mixture. There are related results for other concentrations and for $T_2$. D.H.Whiffen

538.222 : 541.571

5237. EVIDENCE FOR A DOUBLE COVALENT BOND FROM PARAMAGNETIC RESONANCE, OPTICAL ABSORPTION AND X-RAY DATA. M.B.Palma-Vittorelli, M.U.Palma, D.Palumbo and F.Sgarlata.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 718-30 (April, 1956).

Data on paramagnetic resonance absorption, on the distance between the levels responsible for optical absorption, on polarized light absorption and on the structure deduced with X-rays are given which, consistently in agreement with theoretical considerations, confirm the hypothesis previously advanced of the existence of a double covalent bond in the vanadyl group of a vanadylsulphate. A.

538.222

5238. THE PARAMAGNETIC RESONANCE SPECTRUM OF CHLORINE DIOXIDE. J.E.Bennett and D.J.E.Ingram.
Phil. Mag. (Ser. 8), Vol. 1, 109-11 (Jan., 1956).

Electron resonance experiments at 1.25 or 0.8 cm wavelength on $ClO_2$ in alcohol or other solvent at 200° K show 4 hyperfine peaks, overall separation 50 gauss and g = 2.010. In solid solutions there is marked anisotropy, while at 3 cm wavelength the liquid shows one broader line. D.H.Whiffen

538.222

5239. PARAMAGNETIC RESONANCE SPECTRA OF SOME IONS OF THE 3d AND 4f SHELLS IN CUBIC CRYSTALLINE FIELDS. W.Low.
Phys. Rev., Vol. 101, No. 6, 1827-8 (March 15, 1956).

Presents preliminary details of the electron resonance of $Ni^{++}$ in MgO, of $Mn^{++}$ in MgO, of $Eu^{++}$ in $SrCl_2$, of $V^{++}$ in MgO etc. D.H.Whiffen

538.222

5240. RAPID-PASSAGE EFFECTS IN ELECTRON SPIN RESONANCE. R.Beeler, D.Roux, G.Béné and R.Extermann.
Phys. Rev., Vol. 102, No. 1, 295 (April 1, 1956).

538.222

5241. PARAMAGNETIC RESONANCE HYPERFINE STRUCTURE OF $Co^{56}$. R.V.Jones, W.Dobrowolski and C.D.Jeffries.
Phys. Rev., Vol. 102, No. 3, 738-9 (May 1, 1956).

The microwave paramagnetic resonance hyperfine structure of 72-day $Co^{56}$ has been observed in a magnetically dilute single crystal of cobalt potassium sulphate at 20° K. From the number of h.f.s. components and their spacing relative to $Co^{59}$, the spin $I(Co^{56}) = 4$ and the magnetic moment $|\mu(Co^{56})| = 3.855 \pm 0.007$ n.m. are directly determined. These results are discussed in relation to those of nuclear alignment experiments and the nuclear shell model. A.

538.222 : 537.311.33

5242. PARAMAGNETIC RESONANCE IN As-DOPED SILICON. A.Honig and J.Combrisson.
Phys. Rev., Vol. 102, No. 3, 917-18 (May 1, 1956).

The previous results (see Abstr. 2007/1955) are extended and a new explanation in terms of an electronic relaxation time of 16 sec is proposed. D.H.Whiffen



A

538.222

5243. NARROW ELECTRON SPIN RESONANCE IN CHARRED DEXTROSE. R.C.Pastor, J.A.Weil, T.H.Brown and J.Turkevich.
Phys. Rev., Vol. 102, No. 3, 918-19 (May 1, 1956).

A paramagnetic electron resonance 1.1 gauss wide is obtained with dextrose charred to 570° C in vacuum which is much broadened on admission of $O_2$ or NO. D.H.Whiffen

538.222

5244. PARAMAGNETIC RESONANCE IN ANTHRACITE AND OTHER CARBONACEOUS SUBSTANCES. N.S.Garif'yanov and B.M.Kozyrev.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 272-6 (1956). In Russian.

Paramagnetic resonance measurements have been carried out in a number of substances containing free carbon. The measurements were carried out at 295° and 90° K and at frequencies of 9450, 536.71, 176.1 and 20 Mc/s. A.

538.222

5245. PARAMAGNETIC RESONANCE IN SYNTHETIC RUBY. M.M.Zaripov and Yu.Ya.Shamonin.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 291-5 (1956). In Russian.

The paramagnetic resonance absorption spectrum in a single crystal of synthetic ruby containing from 0.1 to 0.01% Cr has been investigated at a frequency of $9.58 \times 10^9$ Mc/s. A theoretical interpretation of the observed spectrum is presented. By comparing the theory and experimental data it is possible to determine the splitting of the ground energy level in the electric field ($\delta = 0.38$ cm$^{-1}$) and the spectroscopic splitting factor ($g_\parallel = g_\perp = 1.98$). A.

538.222 : 621.376.23

5246. THEORY OF THE AUTODYNE DETECTOR FOR PARAMAGNETIC RESONANCE. F.Bruin and F.M.Schimmel.
Physica, Vol. 21, No. 11, 867-76 (Nov., 1955). In French.

The artifice of treating oscillators as combinations of resonant circuits with negative resistances is explained and it shown that either series or parallel circuits may be examined with the same symbolism. The essential differential equation is then solved for the stationary state, for forced oscillations, for time-dependent changes in amplitude and periodic damping. The sensitivity to damping appears to have a maximum value at small amplitudes. Minimum measurable values of the susceptibility of a sample are calculated and compared with that for a passive resonant circuit. The autodyne is rather subject to microphony. The failure of Gorter and Broer, in 1942, to discover nuclear magnetic resonance is attributed to the use of too great an excitation, resulting in saturation.

S.C.Dunn (R)

538.222 : 621.317.4

5247. A SIMPLE APPARATUS FOR CARRYING OUT PARAMAGNETIC RESONANCE MEASUREMENTS. E.Lutze.
Z. angew. Phys., Vol. 8, No. 2, 61-9 (1956). In German.

Describes a 9000 Mc/s paramagnetic electron resonance apparatus, in which the klystron frequency is modulated at 50 c/s so that the cavity resonance can be displayed on an oscilloscope. With accurate frequency markers the Q-factor of the cavity can be determined and plotted as a function of the magnetic field which is varied by hand. Alternatively the oscilloscope base is related to H and the vertical plates to the 50 c/s amplitude so that the envelope of the absorption curve is traced as H is varied stepwise, the resulting pattern being recorded photographically. D.H.Whiffen

538.224

5248. MEASUREMENT OF DIAMAGNETIC ANISOTROPY AT HIGH FREQUENCIES. J.Jousset-Dubien and B.Lemanceau.
C.R.Acad. Sci. (Paris), Vol. 242, No. 9, 1170-2 (Feb. 27, 1956). In French.

An apparatus previously described (Abstr. 3839/1956) is applied for the determination of diamagnetic anisotropy. Th variation of the diamagnetism of naphthalene with density of the powdered sample used for measurement is tabulated.

G.I.W.Llewel

538.2

5249. MEASUREMENT OF PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF CRYSTALS OF BENZENE, BETWEEN −180° AND −2° C. J.Hoarau, N.Lumbroso and A.Pacault.
C.R. Acad. Sci.(Paris), Vol. 242, No. 13, 1702-4 (March 26, 1956). In French.

The three principal diamagnetic susceptibilities of benzene crystals have been determined at various temperatures Curves showing the variation of the magnetic anisotropies with temperature are given. G.I.W.Llewely

538.2

5250. THE MAGNETIC SUSCEPTIBILITIES OF COPPER, SILVER AND GOLD AND ERRORS IN THE GOUY METHOD. W.G.Henry and J.L.Rogers.
Phil. Mag. (Ser. 8), Vol. 1, No. 3, 223-36 (March, 1956).

A direct determination has been made of the absolute magnetic mass susceptibility of copper, silver and gold. Th values at 23° C are: copper, $-0.0850_9 \pm 0.0002_7 \times 10^{-6}$; silver, $-0.1812_8 \pm 0.0005_4 \times 10^{-6}$; gold, $-0.1421_6 \pm 0.0004_8 \times 10^{-6}$, c.g.s. e.m.u. per gram. The probable errors of the relative values are 0.09%, 0.07% and 1.16% respectively. Th correction for ferromagnetic impurities is discussed. From an experimentally determined magnetization curve of the ferromagnetic impurities in a silver specimen, it is shown that, although the error inherent in the long specimen metho is greatly reduced by using a short specimen, an error may remain even when the smallest field acting on any part of the specimen is 6000 gauss. The method of calibrating the field by means of a current-carrying loop and of making allowance for the variation of the field strength in the plane normal to the axis of the specimen are described in detail. A pole piec design which is particularly suitable for the short specimen method is given. A

538.22

5251. THE MAGNETIC SUSCEPTIBILITIES OF SOME DIAMAGNETIC ALLOYS: THE PRIMARY SOLID SOLUTIONS OF ZINC, GALLIUM, GERMANIUM AND ARSENIC IN COPPER. W.G.Henry and J.L.Rogers.
Phil. Mag. (Ser. 8), Vol. 1, No. 3, 237-52 (March, 1956).

The results of the measurements, by a modified Gouy method, of the rates of change of the diamagnetic susceptibil ity with concentration in the solid solution region of the fou systems are presented. A method of alloy preparation is given which, although conducive to some lateral and vertical segregation, produces a sound melt. The magnetic propertie of the systems are discussed theoretically. An interpretatior follows for which it is assumed that all the electrons outsid the $3d^{10}$ shell occupy states in the band and that all but one contribute their normal atomic diamagnetism. Instead of a parabolic band with a positive slope, it is found necessary t use a band which has approximately the same negative slope as that calculated by Jones (1937) for pure copper. The constancy of the density of states curve at the top of the band for a one-dimensional alloy is demonstrated by a first order perturbation treatment. The atomic magnetic susceptibilities as calculated from the self-consistent fields without exchang are given for: $Zn^{2+}$, $Zn(4s)^1$, $Ga^{3+}$, $Ga(4s)^2$, $Ge^{4+}$, $Ge(4s)^2(4p)$ $As^{5+}$, $As(4s)^2(4p)^2$, $Al^{3+}$, $Al(3s)^2$, $Si^{4+}$, $C^0$ and with exchange for $Si^{4+}$ and $C^0$. The results of a preliminary examination of twenty-nine copper, silver and gold based solid solutions ar mentioned. They show the absence of the paramagnetism that would be expected from the existence of the singly occupied states predicted by Mott (1952) and Friedel (1952). A

538.22

5252. ANALYSIS OF CYCLOTRON ABSORPTION IN BISMUTH. B.Lax, K.J.Button, H.J.Zeiger and L.M.Roth.

ys. Rev., Vol. 102, No. 3, 715-21 (May 1, 1956).

Classical magneto-ionic theory is used for calculating the sorption of microwaves in bismuth in the presence of a d.c. agnetic field. The detailed calculations are based on the odels of the energy surfaces in momentum space for holes d electrons obtained from de Haas–van Alphen and galvan-magnetic experiments. Expressions are derived for the con-ductivities and resonance masses. Numerical computations absorption v. magnetic field are made using the data from oenberg's de Haas–van Alphen experiments for the masses the electrons. Since some of the experimental data for the les is incomplete, the analysis takes this into account rough the use of several choices of hole masses. The results e compared with those of preliminary microwave experi-ents. The limitations of the analysis, which neglects the nomalous skin effect and possible anisotropy of scattering are scussed. A.

538.24

253. MAGNETIZATION OF A MAGNETITE SINGLE RYSTAL NEAR THE CURIE POINT. D.O.Smith.
hys. Rev., Vol. 102, No. 4, 959-63 (May 15, 1956).

The isothermal M-H curves of magnetite in the principal rystallographic directions have been measured from room mperature to the Curie point. These curves give the aniso-opy energy and spontaneous magnetization as a function of mperature. Near the Curie point the magnetizing field equired to create a single domain is found to be $< 100$ A/m, ving an unambiguous experimental determination of the ontaneous magnetization in this critical region. Tempera-ure increments of 0.1 deg C define the Curie point with an ncertainty of $< 0.05$ deg C. In the neighbourhood of the Curie oint the M-H curves are very nonlinear; replotting the data in e form of H-T curves at constant magnetization shows that this region the magnetic energy can be expressed as $U_M = \mu_0 WM^2/2$, where W is a constant. A.

538.244.2

254. A GENERAL PURPOSE ELECTROMAGNET.
.Sucksmith and S.P.Anderson.
sci. Instrum., Vol. 33, No. 6, 234-6 (June, 1956).

A general purpose 10 cm pole diameter laboratory electro-agnet is described. Particular attention is given to the mag-tic and electrical circuits, and to those features of con-ruction which are thought to be most important. A.

## ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3

255. . TRANSLATIONAL MOTION OF A SPHERE IN A MAGNETIC FIELD. H.B.Rosenstock and T.A.Chubb.
Amer. J. Phys., Vol. 24, No. 5, 413 (May, 1956).

538.3 : 536.25

256. INFLUENCE OF A MAGNETIC FIELD ON THERMAL ONVECTION PATTERNS. W.C.Levengood.
ature (London), Vol. 177, 631-2 (March 31, 1956).

If a thin layer of silvering solution is run on to a glass heet at different temperature then convection occurs and pre-ipitations takes place in a well-known Bénard cell pattern. epeating the experiment with solution and glass plate at the ame temperature, and warming taking place over small mag-etic poles, gives rise to notably different patterns. Deposi-on over the N pole occurs in straight lines tracing back to a ommon point; over the S pole the lines are of greater curva-ure and do not trace back to a common point. With relatively arge poles a picture is obtained very like that of sun spots. uggestions put forward in 1952 by Chandrasekhar appear to ffer an adequate explanation of the phenomena.

C.R.S.Manders

## ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.561 : 621.3.013 : 621.385.1.029.6

5257. SPACE-CHARGE WAVES IN CROSSED ELECTRIC AND MAGNETIC FIELDS. S.S.Solomon.
J. appl. Phys., Vol. 26, No. 12, 1443-9 (Dec., 1955).

The problem and space-charge waves propagating along a neutralized electron stream moving in a medium pervaded by crossed static electric and magnetic fields is discussed. From energy consideratinns it is shown that gain can be realized either by conversion of the electron kinetic or potential energy into electromagnetic energy. A small signal analysis shows that for the first case the TE- and TM-modes are coupled in general. However, when the electron velocity is much smaller than the velocity of light the coupling coefficients are negligible and the gain realized is identical with that of the conventional travelling-wave tube. A similar analysis for the second case, which is that of the travelling-wave magnetron, yields the interesting result that the TE and TM modes separate even when the electron velocity is comparable with the velocity of light. A.

538.566 : 621.317.34 : 621.396.969

5258. THE RADAR MEASUREMENT OF LOW ANGLES OF ELEVATION. J.S.Hey and S.J.Parsons.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 321-8 (March 1, 1956).

The errors which occur in the measurement of low angles of elevation by centrimetric radar on a flat ground site are estimated theoretically and compared with experimental measurements. It is demonstrated that a very considerable improvement in angular accuracy is obtained by erecting a screen to intercept the ground-reflected wave. The diffraction effects due to the screen are discussed. A.

538.566

5259. SOME PROBLEMS ON OBSTACLES IN A FIELD OF ELECTROMAGNETIC RADIATION. M.Bouix.
Ann. Télécomm., Vol. 10, No. 12, 254-60 (Dec., 1955). In French.

See also Abstr. 1408 (1956). It is first shown that reflection at a surface may be considered as a limiting case of an interface effect between two dielectrics. The reflection of a plane wave from a plane surface is then examined and the more general case of the reflected component from a plane wave incident on an arbitrary, perfectly conducting surface. A physical interpretation is given in terms of surface currents. The fourth and fifth parts of this article have now been withdrawn. S.C.Dunn

538.566 : 535.39 : 534.24

FOURIER TRANSFORM TREATMENT OF THE PROBLEM OF THE REFLECTION OF RADIATION FROM IRREGULAR SURFACES. See Abstr. 4271

538.566 : 621.371

5260. ABSORPTION ARRANGEMENTS FOR THE E.M. CENTIMETRIC WAVES AND THEIR ACOUSTIC ANALOGIES. E.Meyer and H.Severin.
Z. angew. Phys., Vol. 8, No. 3, 105-14 (1956). In German.

Review of the possibilities for the absorption of electromagnetic waves leads to the consideration of acoustic processes, particularly the techniques of sound echo control and noise reduction. The electromagnetic field with its two vectors is represented as a sound field with only one vector magnitude, the sound velocity, and one scalar magnitude, the sound pressure. In order to determine the reflection coefficient of an absorption arrangement, the input and characteristic impedances for the electric and acoustic waves are defined analogously, viz. as quotient of the electric and magnetic field strengths or, as quotient of the amplitudes of sound pressure and sound velocity. The examples described include pyramidal absorbers consisting of paraffin–graphite mixture and, of parallel conducting plates; however, except for certain

special absorbers in the 6 - 9 cm band where it is possible to design devices with broadband characteristics, and reflection coefficients $<0.05$, it is, in general, difficult to obtain this performance in the 3 cm band. Z.F.Wojnar

538.566

5261. EQUATION OF CIRCULAR WAVES IN A GYROPARAMAGNETIC MEDIUM. J.Soutif-Guicherd.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1418-21 (March 12, 1956). In French.

Theoretical study of propagation in a cylindrical waveguide filled with a medium whose permeability is a tensor. Formulae are given for the propagation constants of the two modes corresponding to the simple E- and H-waves, and their development for the case of a paramagnetic medium. For the same case the fields are obtained representing a circularly polarized wave. For E-waves there is only a high-order Faraday effect, for the $H_{on}$-waves there is no Faraday effect, while for the $H_{mn}$-waves the effect is maximum for $n = 1$. L.Pincherle

538.566 : 621.396.677.51 : 621.396.93

5262. AN AUTOMATIC DIRECTION FINDER FOR RECORDING RAPID FLUCTUATIONS OF THE BEARING OF SHORT RADIO WAVES. H.A.Whale and W.J.Ross.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 311-20 (March 1, 1956).

A direction finder which aligns itself along the horizontal projection of the wave normal of a radio wave is described. The system uses two pairs of aerials situated at the corners of a rectangle about 10 m by 5 m, the signals in each pair of aerials being combined in such a way that a required $90^\circ$ phase shift is maintained accurately at all frequencies up to about 17 Mc/s. Sense determination is manual. The accuracy of such a system is discussed and it is shown that the aperture of a direction finder must be small if it is to follow bearing fluctuations when there is an appreciable spread of the component waves in the incoming signal. A.

## THEORY OF SOLID STATE 539.11

539.11 : 537.311.31 : 537.531 : 535.343

5263. BRILLOUIN ZONES, ELECTRICAL CONDUCTIVITY OF METALS, AND X-RAY K ABSORPTION SPECTRA. C.Kurylenko.
Cahiers de Phys., No. 64, 32-44 (Dec., 1955). In French.

Continuation of work described in Abstr. 7228 (1955). The materials examined are mostly binary alloys, particularly brasses. C.A.Hogarth

539.11 : 537.311.31 : 537.531 : 535.343

5264. BRILLOUIN ZONES, ELECTRICAL CONDUCTIVITY OF METALS AND X-RAY K ABSORPTION SPECTRA. C.Kurylenko.
Cahiers de Phys., No. 66, 17-28 (Feb., 1956). In French.

Extension of earlier work on metals (see preceding abstract) to various naturally occurring compounds. The variation with energy of the absorption coefficient is measured and is compared with theory. The refractive index for fast electrons of various metals is deduced. E.H.Sondheimer

539.11

5265. RELATIVISTIC CORRECTIONS TO THE COHESIVE ENERGIES OF THE ALKALI METALS. J.Callaway.
Phys. Rev., Vol. 102, No. 3, 919-20 (May 1, 1956).

It is pointed out that there are relativistic effects, of the same order of magnitude as the spin-orbit coupling term, which will affect the values of calculated effective masses and cohesive energies. E.H.Sondheimer

539.11 : 537.12

5266. THEORY OF INTERACTION BETWEEN ELECTRON GAS AND CRYSTAL LATTICE OSCILLATIONS. V.L.Bonch-Bruevich.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 342-50 (1956). In Russian.

The Green's function method is applied to the problem of interaction between electrons and the phonon field. The electron energy spectrum and electron momentum spectrum at absolute zero have been determined. A

539.11 : 530.14

5267. DISPERSION FORMULAE OF QUANTUM OPTICS OF METALS IN THE MULTI-ELECTRON THEORY CONSIDERING ELECTRON DAMPING. A.V.Sokolov, V.I.Cherepanov and I.B.Shteĭnberg.
Zh. éksper. teor. Fiz., Vol. 28, No. 3, 330-4 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 1, No. 2, 231-4 (Sept., 1955).

539.11

5268. ON METALLIC HYDROGEN. N.H.March.
Physica, Vol. 22, No. 4, 311-14 (April, 1956).

A method is presented for the calculation of the energy of metallic hydrogen as a function of atomic volume for high pressures and the findings are compared with the previous approximate results obtained by Kronig, De Boer and Korringa A

539.11 : 536.7

5269. THERMODYNAMICS AND THE OVERHAUSER NUCLEAR POLARIZATION EFFECT. W.A.Barker and A.Mencher.
Phys. Rev., Vol. 102, No. 4, 1023-9 (May 15, 1956).

A thermodynamical treatment by Brovetto, Cini, and Ferroni of the Overhauser effect in metals and non-metals is extended to apply to nuclear relaxation processes other than that due to the contact interaction. Justification for the method is then presented by an application of the theory of the thermodynamics of irreversible processes using the point of view of the Onsager relations. According to a condition obtained for the validity of the method, the expressions derived for the population of adjacent nuclear Zeeman levels for Boltzmann and for Fermi statistics for the electrons hold essentially over the entire range of field and temperature at which the related experiments may be performed. Perturbation theory is applied to the case of several nuclear relaxation mechanisms, and the results are shown to agree with the thermodynamical results to second order in a power series expansion. A calculation of the small effect of the nuclear-electron dipolar interaction in reducing the Overhauser effect in metallic lithium is reported. A.

539.11 : 539.389.1

5270. THE EFFECT OF TEMPERATURE ON COTTRELL ATMOSPHERES. N.Louat.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 459-67 (April, 1956).

The variation with temperature of solute atom density close to (within $\sim 10$ A) an edge dislocation is examined. The results of this analysis are used to predict the effect of temperature on the yield point. Good agreement is found between theoretical prediction and three apparently dissimilar experimental results. A.

539.11

5271. THEORY OF ORDER–DISORDER KINETICS. G.H.Vineyard.
Phys. Rev., Vol. 102, No. 4, 981-92 (May 15, 1956).

The problem of relating fundamental atom movements to the change of the state of order of an alloy is attacked in a basic manner by introducing an infinite array of distribution functions for the occupation of all possible sets of lattice sites. These distribution functions determine all the kinds of order

the lattice, including the usual long- and short-range order. ey are shown to obey general equations of motion which are ear and in which the kinetic parameters of atom movements cur as coefficients. Solutions of the equations of motion ist be found by approximations, and a variety of possible ocedures are suggested. These depend on expressing higher der distribution functions by combinations of those of lower der. The simplest of these procedures is explored in detail r two mechanisms of atom movement, direct interchange d vacancy interchange, and for two common lattice types, B b.c.c. and $AB_3$ f.c.c. The result is a calculation of the ne dependence of long range order in homogeneous systems, d is expected to be reliable whenever the long-range order reasonably high. The simple theory leads to the Bragg–illiams result at equilibrium, and gives a fundamental deriv-ion and limitation of the conception that ordering is a hemical reaction" of the type $A^{\alpha} + B^{\beta} \rightleftharpoons A^{\beta} + B^{\alpha}$. The cancy and direct interchange models lead to qualitatively milar, but not identical results. Present evidence suggests edominance of the vacancy mechanism, at least in close-cked systems. The simple vacancy model is applied to periments of Burns and Quimby on electrical resistivity in $_3$Au. The observed relaxation times, over a range of tem-ratures below the critical temperature, are in reasonably od accord with theory when parameters derived from dif-sion measurements in Cu and Au are employed. A.

539.11

272. ON THE APPLICATION OF THE THOMAS–FERMI–IRAC METHOD TO THE STUDY OF THE RESIDUAL RE-ISTANCE OF BINARY ALLOYS CONTAINING FOREIGN TOMS IN SMALL CONCENTRATIONS. H.Fujiwara.
. Phys. Soc. Japan, Vol. 11, No. 4, 376-82 (April, 1956).

By taking the exchange interaction among electrons into ccount, the modified screened potential around the substitut-onal impurities of di- or trivalent metal in monovalent metal n dilute solid solution is exactly obtained from the Thomas–ermi–Dirac type equation by numerical integration. As one f the applications of the potential obtained, the residual re-istance due to the foreign atoms was taken. The method of artial waves together with the Born approximation was used or the calculation of the scattering cross-section, and the esidual resistance calculated. The disagreement of theoret-cal values with experiment has been greatly reduced by in-roducing exchange effects. A.

## MOLECULES 539.13

539.13

273. INTERMOLECULAR FORCES IN ETHANE. V.Myers.
. chem. Phys., Vol. 24, No. 4, 924 (April, 1956).

The long-range forces are computed from optical disper-sion, short-range ones estimated from second virial coeffs.
J.Jacobs

539.13 : 539.132 : 548.7

274. NOTE ON VIBRATIONS OF LINEAR CHAINS OF ARTICLES. B.C.DeLoach and W.H.Shaffer.
. chem. Phys., Vol. 24, No. 5, 1114 (May, 1956).

Gives an approximate analytical formula for the longitud-nal normal frequencies of a free-ended chain of N identical asses, with nearest and next-nearest neighbour interactions.
J.Hawgood

539.13

275. VIRIAL COEFFICIENTS AND INTERMOLECULAR OTENTIAL FOR SMALL NONSPHERICAL MOLECULES. T.Kihara, Y.Midzuno and S.Kaneko.
. Phys. Soc. Japan, Vol. 11, No. 4, 362-6 (April, 1956).

It is proved that for a special model of nonspherical inter-nolecular potential the nonspherical correction to the virial coefficients is equivalent to the quantum correction. The second and third virial coefficients of hydrogen is investigated by use of this model, and the intermolecular potential, which can be compared with the result of quantum-mechanical calculations, is determined. The model is also applied to the second virial coefficient between argon and hydrogen. A.

539.13

5276. THE ELECTRONIC STATES OF COMPOSITE SYSTEMS. H.C.Longuet-Higgins.
Proc. Roy. Soc. A , Vol. 235, 537-43 (June 19, 1956).

In order to relate the electronic eigenstates of a composite system to those of its constituent parts one requires the matrix elements of the interaction Hamiltonian between the unperturbed states of the system. It is shown that in the absence of electron exchange these matrix elements, which are usually approximated as multipole series, may be accurately expressed as electrostatic repulsion energies between three-dimensional electric distributions localized on the subsystems. These distributions are themselves the matrix elements of the electric density operator between the eigenstates of the individual subsystems, and their multipole moments are identified as the permanent moments of the subsystems in their various states and the transition moments between these states. The name "transition density" is proposed for the off-diagonal elements of the electric density operator, and an examination of its properties suggests that the transition density may be a useful concept for summarizing and systematizing spectroscopic data on atomic and molecular assemblies. A.

539.13

5277. THE THEORY OF MOLECULAR ATTRACTIVE FORCES BETWEEN SOLIDS. E.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 29, No. 1(7), 94-110 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 73-83 (Jan., 1956).

A macroscopic theory is developed for the interaction of bodies whose surfaces are brought within a small distance of one another. The interaction is considered to come about through the medium of the fluctuating electromagnetic field. The limiting cases of separations small and large compared with the wavelengths of the absorption bands of the solid are studied. Upon going to the limiting case of rarefied media, the van der Waals forces of interaction between individual atoms are obtained. The effect of temperature on the interaction of the bodies is considered. A.

539.132 : 537.564

5278. DISSOCIATION ENERGY OF CARBON MONOXIDE. T.E.Brackett.
J. chem. Phys., Vol. 24, No. 5, 1103 (May, 1956).

It is possible to resolve a conflict between recent work indicating D(CO) = 11.1 eV (Abstr. 8055/1955), and electron impact studies on $CH_4$ (Abstr. 1011/1955) which were consistent with the old value, D(CO) = 9.6 eV. The assumed reaction was $e^- + CH_4 \rightarrow C^+ + 4H + 2e^-$; if instead it were $e^- + CH_4 \rightarrow C^+ + 2H^- + 2H$, the predicted value would be D(CO) = 11.1 eV, removing the discrepancy. J.Hawgood

539.132

5279. LINEAR EXTRAPOLATION OF THE VIBRATIONAL ENERGY LEVELS OF IONIC MOLECULES. C.L.Beckel
J. chem. Phys., Vol. 24, No. 4, 923-4 (April, 1956).

A re-examination of dissociation energies of the alkali halides tends to confirm the ratio $D_i/D_{lin} > 1$. Here $D_{lin}$ is the dissociation energy from linear extrapolation of vibrational energy levels, and $D_i = D_0 + I - E$ that of the molecule into ions, I ionization energy of the metallic atom, E electron affinity of the non-metallic atom, $D_0$ true dissociation energy.
J.Jacobs

539.132

5280. STATISTICAL METHOD AND MOLECULAR BINDING. W.Kołos.
Phys. Rev., Vol. 102, No. 4, 1052 (May 15, 1956).

The effect of the Weizsäcker correction on the interaction energy of two nitrogen atoms has been studied. By using an electron density function with two variational parameters, repulsion of the atoms is obtained. However, the repulsion energy is reduced from 12.0 atomic units to 4.4 atomic units when the Weizsäcker correction is included in the calculations. By comparing results with those of Sheldon it may be expected that in a higher approximation, e.g., using more variational parameters in the electron density function, it would be possible to get a binding. A.

539.132

5281. DOUBLY CHARGED DIATOMIC MOLECULAR IONS. D.R.Bates and T.R.Carson.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1199-202 (Dec., 1955).

The stabilities of ions $XY^{2+}$ of two types, A, which give $X + Y^{2+}$, and R, which give $X^+ + Y^+$, on dissociation, are considered. For type A, the polarization of X by $Y^{2+}$ leads to a potential which is attractive over a considerable range of distance. Exact calculations for $HeH^{2+}$ ($2p\sigma$), dissociating to $He^{2+} + H(1s)$, give $r_e = 2.06$ A, $D_e = 0.85$ V. Stable type A ground states will be formed if the difference in ionization potentials, $I(X) - I(Y^+)$, is positive. This is seldom so: important exceptions are for X = inert gas, Y = alkaline earth, and stable ions like $NeMg^{2+}$ should be formed in 3-body collisions. A number of $XY^{2+}$ ions with type R ground states are effectively stable. In certain cases, the potential curve for the ground state $V_R$ will interact with that for the first A state, $V_A$, to give a repulsive curve for $r > r_c$, but with a minimum at $r < r_c$. Such stable ions might be formed by high-energy ionizing impacts. Type-R ions may have stable excited states, so that they might be detected spectroscopically. The cases of $SiO^{2+}$, $O_2^{2+}$ and $N_2^{2+}$ are briefly considered. R.F.Barrow

539.132

5282. INTERACTION OF STRETCHING VIBRATIONS AND INVERSION IN AMMONIA. W.S.Benedict and E.K.Plyler.
J. chem. Phys., Vol. 24, No. 4, 904 (April, 1956).

Interaction of modes other than $\nu_2$ with inversion were studied by observing the 4050-4720 $cm^{-1}$ region of $NH_3$. A comparison of energy differences due to inversion doubling observed in the combination bands with those in the $\nu_2$ fundamental shows a decreased splitting in the upper state. J.Jacobs

539.132

5283. APPLICATION OF THE VIBRATIONAL SUM RULE TO HALOGENATED ETHYLENES. H.J.Bernstein.
J. chem. Phys., Vol. 24, No. 4, 910 (April, 1956).

The sum rule of Bernstein and Pullin is applied and gives 149 $cm^{-1}$, 170 $cm^{-1}$ respectively for the unknown in-plane and out-of-plane modes of transdibromoethylene. J.Jacobs

539.132

5284. CORRELATION OF SYMMETRICAL VIBRATION FREQUENCIES. H.T.Hahn.
J. chem. Phys., Vol. 24, No. 4, 921 (April, 1956).

Calculations made using an expression proposed by Bigeleisen and Mayer (Abstr. 2286/1947) show that the ratio of the partition functions of heavy and light isotopes follow the order oxide > fluoride > bromide ≥ chloride, for a given central atom. G.I.W.Llewelyn

539.132

5285. OUT OF THE PLANE BENDING VIBRATIONS OF PLANAR MOLECULES. C.J.S.M.Simpson.
J. chem. Phys., Vol. 24, No. 5, 1108-9 (May, 1956).

Theoretical. Terms in the potential energy linear in the interbond angles need not be zero for strained angles, such as those in $BF_3$ and ring compounds; the introduction of such terms gives good results in predicting the out-of-plane frequency for $B_2D_6$ from that for $B_2H_6$. J.Hawgood

539.13:

5286. THE STUDY OF ACETYLENE BY THE METHOD OF ATOMS IN MOLECULES. J.Serre.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1469-71 (March 12 1956). In French.

Energies of the various singlet and triplet configurations are computed and compared with those obtained by the metho of antisymmetrized molecular orbitals, including configurati interaction. All singlet–triplet separations are much reduce including those of $\Sigma_u^+$ symmetry. J.Jacobs

539.13

5287. ELECTRONIC STATES OF DIATOMIC MOLECULES THE $O_2^+$ MOLECULAR ION. F.Bassani, E.Montaldi and F.G.Fumi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 893-901 (May, 1956)

The scheme proposed by Fumi and Parr (Abstr. 1532/195 for the calculation of electronic energy levels of diatomic mo cules is applied to the oxygen molecular ion in the $\pi$-electron approximation, using one empirical parameter. The vertical excitation energies from the ground state $^2\Pi_g$ to the $^4\Pi_u$ and $^2\Pi_u$ states are computed as functions of distance between 1.01 A and 1.46 A, and they agree with the observed values within 0.1 eV. The relative position of the $^4\Pi_u$ and $^2\Pi_u$ state is predicted correctly. The excitation energies to the unobserved states $^2\Phi_u$, $^4\Pi_g$ and $^2\Phi_g$ were also computed, but shou be considered of purely indicative value. A

539.13

5288. ON THE METHOD OF ATOMS IN MOLECULES. III. THE GROUND STATE OF HYDROGEN FLUORIDE. A.C.Hurley.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 301-9 (April, 1956).

For Pt II, see Abstr. 1446 (1956). Techniques suggested by the results of calculation on the hydrogen molecule are used to calculate the properties of hydrogen fluoride. The most satisfactory results are obtained using an intra-atomic correlation correction theory. This theory predicts a binding energy of 5.84 eV and a dipole moment of 1.33 Debye units, the experimental values of these quantities being 6.08 eV and 1.91 Debye units respectively. A

539.132 : 548.3

5289. NUCLEAR MAGNETIC RESONANCE STUDIES OF BROMINE NUCLEI IN AMMONIUM BROMIDE. J.Itoh and Y.Yamagata.
J. chem. Phys., Vol. 24, No. 3, 621 (March, 1956).

The nuclear magnetic resonance signals for the Br ions in $NH_4Br$ are described. In phase I, 138° C, there is a paramagnetic shift with respect to $Br^-$ ion in water solution of $1.3 \times 10^{-4}$; in phase II, −38° C to 138° C, the shift is $2.5 \times 10^{-}$ and $T_1$, the relaxation time, is proportional to exp (−1800/T) and has the value $0.59 \times 10^{-4}$ sec at 12° C. There appears to be H bonding with the neighbouring $NH_4^+$ ions with an average of 1.8% covalency. Phase III, below −38° C, shows a strong frequency displacement which is temperature dependent and due to the electrical quadrupole coupling which no longer averages to zero. eqQ rises from 1 Mc/s at −40° C to 5.5 Mc/s at −130° C and below. D.H.Whiffen

539.132

5290. PURE QUADRUPOLE SPECTRA OF PHOSPHONITRI CHLORIDES. H.Negita and S.Satou.
J. chem. Phys., Vol. 24, No. 3, 621-2 (March, 1956).

539.132

5291. ZEEMAN QUADRUPOLE SPECTRA OF p-CHLORO-ANILINE AND p-CHLOROBENZYLCHLORIDE. H.C.Meal.
J. chem. Phys., Vol. 24, No. 5, 1011-17 (May, 1956).

Analysis of the Zeeman quadrupole spectra of $Cl^{35}$ in sing crystals of p-chloroaniline and p-chlorobenzylchloride yields the following information: There are two sets of chlorine atoms in the p-chloroaniline crystal with differently oriented

ctrical field gradients. The angle between the field gradient xes is 79° ± 1°; the y-axes are parallel. Both field gradients e the same asymmetry, $\eta = 0.06 \pm 0.03$. In p-chlorobenzyl- oride there are four sets of chlorines (attached directly to ring) which have differently oriented field gradients. The xes are parallel to the edges of a rectangular pyramid with ex angles of 8° and 67°, both ± 1°. All four have the same mmetry, $\eta = 0.07 \pm 0.02$. The bond between the chlorine and ring is calculated to have 2.0 ± 1.0% double bond, 79 ± 10% gle bond and 19 ± 10% ionic character in p-chloroaniline; ± 0.7% double bond, 80 ± 10% single bond and 17 ± 10% ic character in p-chlorobenzylchloride. The large uncer- nty in the single bond and ionic characters results from the certainty in the hybridization of the chlorine bonding orbital.
A.

539.132

92. NUCLEAR QUADRUPOLE COUPLING IN POLAR OLECULES. R.M.Sternheimer and H.M.Foley.
ys. Rev., Vol. 102, No. 3, 731-2 (May 1, 1956).

The quadrupole moment induced in various ions by the clear electric quadrupole moment Q has been recalculated higher accuracy than in a previous paper. Values are pre- nted for the ratio $\gamma_\infty$ of the induced moment to Q for the $Na^+$, $^-$, $Cu^+$, $Rb^+$ and $Cs^+$ ions. These values of $\gamma_\infty$ enter into the adrupole coupling of polar molecules, which is given by $\simeq 2e(1+|\gamma_\infty|)/R^3$ (R = internuclear distance) provided that e exchange repulsion of the ions can be neglected. The cal- lated values of $\gamma_\infty$ are of order 10-100, in agreement with perimental evidence from the measured values of q for veral polar molecules.
A.

539.132

93. NUCLEAR MAGNETIC RESONANCE ABSORPTION POLYISOBUTYLENE. J.G.Powles.
oc. Phys. Soc. B, Vol. 69, Pt 3, 281-92 (March 1, 1956).

The proton magnetic resonance absorption in polyisobuty- ne has been measured over the temperature range −196° C 90° C. The unusually large width of the absorption line at e lowest temperatures is interpreted as largely due to the ell known close approach of the methyl groups on alternate rbon atoms in the chain. The usual reduction in line width sociated with reorientation of methyl groups about their $c_3$ is is notably absent and supports the contention that the ethyl groups are severely interlocked. A reduction in the cond moment of the absorption line which sets in over a nge of temperature near −10° C is associated with chain otion. A satisfactory correlation has been obtained between is observation and measurements of mechanical properties. xperiments on PIB swelled with benzene substantiate the terpretation given above and suggest that valuable information s to the nature of the swelling process of rubber-like poly- ers may be obtained by means of nuclear resonance studies.
A.

539.132

294. STUDY OF TWO-CENTER INTEGRALS USEFUL IN ALCULATIONS ON MOLECULAR STRUCTURE. III. A UNI- IED TREATMENT OF THE HYBRID, COULOMB, AND ONE- LECTRON INTEGRALS. K.Ruedenberg, C.C.J.Roothaan and .Jaunzemis.
chem. Phys., Vol. 24, No. 2, 201-20 (Feb., 1956).

For Pt II, see Abstr. 2009 (1952). The problem of the two- entre hybrid integrals is solved in a general way for Slater- pe atomic orbitals with integral effective quantum numbers. o other restrictions are placed upon effective quantum num- ers and effective nuclear charges. The integrals are expres- ed linearly in terms of one type of auxiliary functions. A ethod for finding the coefficients is given, and the latter are mputed for all cases involving orbitals with quantum num- ers 1 and 2. The auxiliary functions are discussed in detail, nd methods given for their computation. The treatment eveloped for the hybrid integrals is shown to be applicable so to the two-centre Coulomb integrals and to the one- ectron integrals.
A.

539.132

5295. STUDY OF TWO-CENTER INTEGRALS USEFUL IN CALCULATIONS ON MOLECULAR STRUCTURE. IV. THE AUXILIARY FUNCTIONS $C_{\alpha\beta}{}^{\gamma\delta\epsilon}(\rho_a, \rho_b)$ FOR $\alpha \geq 0$.
C.C.J.Roothaan.
J. chem. Phys., Vol. 24, No. 5, 947-60 (May, 1956).

A new method is developed for the numerical computation of the auxiliary functions $C_{\alpha\beta}{}^{\gamma\delta\epsilon}(\rho_a, \rho_b)$ which are used in (III) in this series, for the case $\alpha \geq 0$. The present method is suitable for all values of the parameter $\tau = (\rho_a - \rho_b)/(\rho_a + \rho_b)$, avoiding the excessive loss of significant figures which occurs in the methods developed in (III) for the physically important case of small $\tau$.
A.

539.132 : 537.561

5296. IONIZATION POTENTIALS OF XYLENES AND PICOLINES. K.Higasi, I.Omura and H.Baba.
J. chem. Phys., Vol. 24, No. 3, 623-4 (March, 1956).

Replacement of a C—H group by N raises, and $CH_3$ substitution lowers, the appearance potential. The latter is less marked in pyridine than benzene, suggesting that in benzene derivatives $\pi$-electrons determine the ionization potential, and in pyridine the nonbonding N atom electrons.
J.Jacobs

539.132

5297. ON THE FREE ELECTRON TREATMENT OF ELECTROPHILIC SUBSTITUTION IN ANILINE. L.S.Bartell and R.A.Bonham.
J. chem. Phys., Vol. 24, No. 4, 909-10 (April, 1956).

Criticism of Basu's work (Abstr. 2968/1955) and of the application in general of the free-electron model to activation energy calculations.
J.Hawgood

539.132

5298. SYMMETRY ASSIGNMENTS OF THE SECOND EXCITED SINGLET ELECTRONIC STATE OF ANTHRACENE.
D.Fox and S.Yatsiv.
J. chem. Phys., Vol. 24, No. 5, 1103 (May, 1956).

Theoretical. Discusses the effect of the size of the exciton wave packet on the results of Craig and Hobbins (Abstr. 5322/1955), who assigned the 2500 A transition as long-axis polarized by considering the frequency shift and splitting of the band in the crystal. They are criticized for neglecting dipole—dipole interactions between molecules more than 20 A apart, and their conclusion that the splitting can be used to make the assignment is disputed. The shift is consistent only with long-axis polarization for exciton packet length more than 100 A, and possibly for smaller packets.
J.Hawgood

539.132

5299. CONFIGURATION INTERACTION AS METHOD OF CALCULATING MOLECULAR ORBITALS OF THE SELF-CONSISTENT FIELD. I. STATES WITH COMPLETE LAYERS. CASE OF ALTERNATING-PAIR CONJUGATED HYDROCARBONS. R.Lefebvre and M.Moser.
J. Chim. phys., Vol. 53, No. 4, 393-9 (April, 1956). In French.

A perturbation method is proposed by which the initial approximately self-consistent molecular orbitals are improved. These are made into an orthonormal system and the iteration is repeated. These corrections can also be obtained by diagonalizing the configuration interaction matrix at each iteration. Application is made to the ground state of some conjugated hydrocarbons.
J.Jacobs

539.133 : 535.338.42

5300. STUDY OF THE ROTATION SPECTRUM AND THE MOMENTS OF INERTIA OF THE MOLECULE OF FORMIC ACID. R.Wertheimer.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1591-3 (March 19, 1956). In French.

The frequencies of 23 transitions are tabulated and used to calculate the moments of inertia.
G.F.Lothian

539.133 : 535.324

5301. DISPERSION OF INFRARED RADIATION IN THE VIBRATION–ROTATION BANDS OF HYDROCHLORIC ACID. F.Legay.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1593-5 (March 19, 1956). In French.

Refractive index measurements made with a Twyman interferometer in the 3.4 and 1.7 $\mu$ bands are used to calculate the moment of inertia in debyes at $1.092 + 0.953\,(r - r_0) - 0.275\,(r - r_0)^2$, where $(r - r_0)$ is the change in internuclear distance in angstroms. G.F.Lothian

539.133 : 535.343

BOND MOMENTS IN $BF_3$ AND RELATED MOLECULES.
See Abstr. 4316

539.133

5302. ON THE BOND LENGTH AND THE MEAN SQUARE AMPLITUDE OF C-O BOND IN METHYL ALCOHOL. M.Kimura, K.Kimura and S.Shibata.
J. chem. Phys., Vol. 24, No. 3, 622 (March, 1956).

Values of 1.426 A and 0.052 A respectively have been obtained for these distances using an electron diffraction camera with a rotating sector. G.I.W.Llewelyn

539.133 : 535.343

5303. MICROWAVE SPECTRUM AND MOLECULAR STRUCTURE OF $(CH_3)_3SiI$. H.N.Rexroad, D.W.Howgate, R.C.Gunton and J.F.Ollom.
J. chem. Phys., Vol. 24, No. 3, 625 (March, 1956).

The rotational transitions from 32-38 kMc/s are partly interpreted and require $B_0 = 1096.42 \pm 0.02$ Mc/s whence Si–I = 2.46 ± 0.02 A, with the assumptions Si–C = 1.81, C–H = 1.093 A and angles are tetrahedral. D.H.Whiffen

539.133

5304. GENERAL METHODS OF DETERMINING THE MASSES AND DIMENSIONS OF MACROMOLECULES. C.Sadron.
Bull. Soc. Chim. France, 1956, No. 4, 529-34 (April). In French.

After defining the macromolecule and stressing the importance of the dispersions of macromolecules in liquid media, the author describes the two extreme types of macromolecules and discusses the properties of molecular chains. Different methods for determining masses and the shape and dimension parameters of macromolecules in solutions are discussed, viz. methods based on statistical interpretation of the entropy of solution, and those based on the properties of the aggregation of N points constituting the macromolecule (hydrodynamical, optical and electrical methods). F.Lachman

539.133

5305. STRUCTURE OF FEATHER KERATIN. S.Krimm and R.Schor.
J. chem. Phys., Vol. 24, No. 4, 922-3 (April, 1956).

It is suggested by X-ray evidence, that the fundamental unit is a helical extended polypeptide chain of pitch 190 A and radius 8.0 A. In the 190 A there are 8 uniformly spaced proline residues. Ten of these helices are aggregrated by means of hydrogen bonding. Seven cylindrical units form a somewhat stable aggregate. C.Turner

539.133

5306. CONTRIBUTION OF ELECTRIC MOMENTS TO THE STUDY OF SOLUTIONS OF CHAIN-LIKE MACROMOLECULES. J.Marchal and H.Benoit.
J. Chim. phys., Vol. 52, No. 11-12, 818-25 (Nov.-Dec., 1955). In French.

Information about low molecular weight polymers similar to that obtained for high polymers from light scattering experiments is obtained by measurement of the dipole moments of dilute solutions of the polymers. The method proposed by Guggenheim (Abstr. 8884/1951) was used to make the measurements, which were carried out on samples of polyoxyethylene glycols of varying degrees of polymerization from 2 to 227 in solution in benzene. Two samples of diethoxyl polyethyleneglycols were also studied. The value of $\bar{\mu}^2/n$ was found to decrease rapidly with increasing n to a limiting value of 1.13 (n = number of elementary moments per molecule, $\mu$ = mean dipole moment in Debye units). The results are justified experimentally. P.Cuck

## ATOMS. NUCLEUS. ISOTOPES 539.15

539.15

5307. ISOTOPIC SPIN SELECTION RULES. VI. THE 6.88 MeV STATE OF $^{10}B$. D.H.Wilkinson and A.B.Clegg.
Phil. Mag. (Ser. 8), Vol. 1, No. 3, 291-7 (March, 1956).

For Pt V, see Abstr. 9510 (1954). The radiations emitted by the 6.88 MeV level of $B^{10}$ are described and analysed in detail. It is shown that in all probability this state is 1 –, T = 0 but that it suffers some tens of per cent contamination by T = 1. It is suggested that this state is formed of $Be^9$ in its ground state acting as the unique parent for an additional s-wave proton; this very strong contamination could then be due to the presumed near presence of the similarly constituted T = 1 state. A

539.152

5308. MULTIPLE THERMAL RELAXATION TIMES AND NUCLEAR SPIN ENERGY TRANSFER IN LIQUIDS. J.E.Wertz, P.L.Jain and R.L.Batdorf.
Phys. Rev., Vol. 102, No. 3, 920-1 (May 1, 1956).

Distinguishable protons in a molecule may have different spin relaxation times as indicated by different decays of the "wiggles" patterns in nuclear magnetic resonance. Spin saturation may occur at different r.f. amplitudes and relative intensity is no longer a measure of the number of protons of each type. With $CH_3OH$ using high r.f. powers observation of the $CH_3$ resonance causes equalization of the OH spin level populations, through $I_1 \cdot I_2$ coupling, and consequent loss of OH resonance which can not be observed immediately after the $CH_3$ resonance. If the OH resonance is observed first the $CH_3$ resonance can be seen thereafter. D.H.Whiffen

539.152

5309. DETERMINATION OF THE TRANSVERSE RELAXATION TIME OF NUCLEAR MAGNETIC MOMENTS. S.D.Gvozdover, N.M.Pomerantsev and A.L.Polyakova.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 584-8 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 471-4 (Nov., 1955).

The transverse relaxation time $T_2$ for nuclear spins is obtained from the ratio of the first two extrema of a nuclear magnetic resonance signal with rapid passage through resonance. The theory is discussed and results given for protons in aqueous $CuSO_4$ solutions for which $1/T_2$ changes linearly with $Cu^{++}$ concentration. D.H.Whiffen

539.152.1 : 778.34

5310. A CONTRIBUTION TO THE STUDY OF SOME EXCITED STATES OF HEAVY NUCLEI BY MEANS OF EMULSIONS SENSITIVE TO INDIVIDUAL ELECTRON TRACKS. G.Albouy.
Ann. Phys. (Paris) (Sér. 13), Vol. 1, 99-151 (Jan.-Feb., 1956). In French.

The photographic technique has been used to determine the low-lying excited states of some heavy radioactive nuclei. The elements are loaded into the emulsion and conversion-electron tracks in association with $\alpha$-particle tracks are measured, the range giving a measure of the excited state. In certain cases it has been possible to determine the angular correlation between the electron and the decay $\alpha$-particle.

Most of the transitions examined are of the E 2 type in agreement with theory. Second excited states determined in $U^{233}$ and $Pu^{239}$ have been identified as rotation levels of the Bohr and Mottelson type. A section is devoted to the technical difficulties involved such as background eradication, and processing. There are 93 references. D.J.Prowse

539.152.1

5311. NUCLEAR SCATTERING OF HIGH ENERGY ELECTRONS BY LIGHT ELEMENTS. M.K.Advani and K.M.Gatha.
Curr. Sci., Vol. 25, No. 2, 53-4 (Feb., 1956).

A brief analysis of experimental results indicates that the characteristic nuclear neutron density distribution predominates over the characteristic nuclear proton distribution near the nuclear periphery. A.O.Stanesby

539.152.1

5312. OPTICAL MODEL OF NUCLEUS WITH ABSORBING SURFACE. F.E.Bjorklund, S.Fernbach and N.Sherman.
Phys. Rev., Vol. 101, No. 6, 1832-3 (March 15, 1956).

The differential cross-section for 14.6 MeV neutrons on Mg, Ca, Cd, and Bi is analysed by means of the optical model with the usual tailed well for the real part, and a Gaussian well, centred at the nuclear surface, for the imaginary part of the potential. P.T.Matthews

539.152.1

5313. RELATED jj-COUPLING CONFIGURATIONS IN $K^{40}$ AND $Cl^{38}$. S.Goldstein and I.Talmi.
Phys. Rev., Vol. 102, No. 2, 589-90 (April 15, 1956).

The first three excited states of $Cl^{38}$ are calculated from those of $K^{40}$, assuming pure jj-coupling. Excellent agreement with experiment is obtained. P.T.Matthews

539.152.1

5314. NUCLEAR SPINS OF $Mo^{95}$ AND $Mo^{97}$. J.Owen and I.M.Ward.
Phys. Rev., Vol. 102, No. 2, 591-2 (April 15, 1956).

Paramagnetic electron resonance of Mo diluted in $K_3InCl_6 \cdot 2H_2O$ show $Mo^{95}$ and $Mo^{97}$ each to have I = 5/2 as indicated by the six hyperfine lines which are doubled since there are two inequivalent Mo positions. The Hamiltonian for the $Mo^{5+}$ state is given. D.H.Whiffen

539.152.1

5315. ON NEUTRON–PROTON PAIRING INTERACTION IN HEAVY NUCLEI. S.N.Ghoshal and A.N.Saxena.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 293-300 (April, 1956).

The effect of neutron–proton pairing interaction between the last odd neutron and the last odd proton in the outermost neutron and proton shells of a nucleus has been demonstrated by the last neutron binding energy and the last proton binding energy plots in the heavy nuclei. The n-p pairing interaction has been estimated for nuclei in the region $Z > 82$ and $N > 126$ and it has been successfully used to explain the neutron and proton binding energy plots. The interaction energy seems to decrease with increase in the difference between neutron and proton numbers in the outermost neutron and proton shells respectively for nuclei in the region of $Z > 82$ and $N > 126$. A.

539.152.2 : 535.33

OPTICAL METHODS OF MAGNETIC RESONANCE. See Abstr. 4290

539.152.2 : 538.247

5316. A NEW METHOD FOR POLARIZATION OF ATOMIC NUCLEI. A.Abragam.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1720-2 (March 26, 1956). In French.

Adiabatic demagnetization of a solid containing paramagnetic centres, in a time short compared with the spin-lattice relaxation time $T_1$, induces nuclear polarization decaying with a time constant of the order of $T_1$. A.O.Stanesby

539.152.2

5317. THE QUADRUPOLE MOMENT OF $V^{51}$. K.Murakawa.
J. Phys. Soc. Japan, Vol. 11, No. 4, 422-5 (April, 1956).

The hyperfine structure (h.f.s.) of the spectrum of V I was investigated. From the h.f.s. of $\lambda$ 4851 the quadrupole coupling constant of the ground level $3d^34s^{2/4}F_{3/2}$ was deduced. Assuming that the screening correction for the d-electron of V I is 13, the quadrupole moment of $V^{51}$ was calculated to be $(0.2_8 \pm 0.15)10^{-24}$ cm$^2$, in which the polarization correction due to Sternheimer is taken into account. The indicated probable error does not include the uncertainty of the screening correction of the d-electron. In addition to the h.f.s. of $\lambda$ 4851, the h.f.s. of $\lambda\lambda$ 4881, 4875, 4832, 4594, 4330 were measured, and the interval factors of the quartet levels $3d^34s^{2/4}F$ and of $3d^34s4p\ ^4G_{11/2}$ A.

539.152.2

5318. NUCLEAR MOMENTS OF $Hf^{177}$ AND $Hf^{179}$. D.R.Speck and F.A.Jenkins.
Phys. Rev., Vol. 101, No. 6, 1831-2 (March 15, 1956).

Spectra observed by multilayer coated Fabry–Perot etalons can only be explained by assigning spin I = 7/2 to $Hf^{177}$ and I = 9/2 to $Hf^{179}$. G.E.Brown

539.152.2

5319. EXPERIMENTAL VERIFICATION OF THE OVERHAUSER NUCLEAR POLARIZATION EFFECT. T.R.Carver and C.P.Slichter.
Phys. Rev., Vol. 102, No. 4, 975-80 (May 15, 1956).

The experimental verification of Overhauser's proposal for polarizing nuclear spins is described. The effect on the nuclear magnetic resonance of saturating the electron spin resonance in several appropriate systems was observed at low fields and room temperatures. The systems investigated were: metallic Li, metallic Na, and Na dissolved in anhydrous liquid ammonia. The nuclear resonances of $Li^7$, $Na^{23}$ and $H^1$ (in the ammonia) were observed at 50 kc/s in fields of 30.3 gauss, 44.2 gauss, and 11.7 gauss respectively, and the electron spin resonances were saturated with the corresponding applied frequencies of 84, 124 and 33 Mc/s. The detailed predictions of Overhauser were confirmed as far as nuclear polarization is concerned, although other relaxation processes in Li reduce the polarization, and the difficulty in completely saturating the metallic Na electron resonance leads to a partial effect. Only in fairly concentrated solutions of Na in ammonia was a substantially complete effect observed in which the proton nuclear polarization increased by the ratio of the electron gyromagnetic ratio to the nuclear gyromagnetic ratio. The proton line widths in the Na-ammonia solutions further verify the theory of Kaplan and Kittel. A.

539.152.2

5320. NUCLEAR MOMENTS OF $Am^{241}$ AND $Am^{243}$. T.E.Manning, M.Fred and F.S.Tomkins.
Phys. Rev., Vol. 102, No. 4, 1108 (May 15, 1956).

The following values have been derived from measurements of hyperfine structure in the spectrum of americium: $\mu_{241} = +1.4$ n.m., $Q_{241} = +4.9 \times 10^{-24}$ cm$^2$, $\mu_{241}/\mu_{243} = +1.00 \pm 0.01$, $Q_{241}/Q_{243} = +1.00 \pm 0.01$. A.

539.152.2 : 534.321.9

5321. ULTRASONIC SATURATION OF NUCLEAR MAGNETIC ENERGY LEVELS. W.G.Proctor and W.A.Robinson.
Phys. Rev., Vol. 102, No. 4, 1183-4 (May 15, 1956).

Ultrasonic radiation at 9.5 Mc/s induces $\Delta m = \pm 2$ transitions for $Na^{23}$ nuclei of a NaCl crystal in a magnetic field of 4220 Oe. The effect is observed as a reduction of nuclear magnetic resonance signals at 4.75 Mc/s observed 0.03 sec after removal of the ultrasonic radiation. With 1.2 W on the quartz transducer the m = 3/2 to m = −3/2 population difference is reduced to 26% of that at equilibrium. D.H.Whiffen

539.152.2

5322. DETERMINATION OF TRANSVERSE RELAXATION TIMES IN THE MAGNETIC RESONANCE OF ATOMIC NUCLEI IN WEAK HIGH FREQUENCY MAGNETIC FIELDS.
S.D.Gvozdover and N.M.Ievskaya:
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 227-36 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 90-7 (Jan., 1956).

A method of measurement of the transverse relaxation times is developed, based on the determination of the interval of time between the extrema of the dispersion signal in a weak high-frequency magnetic field in the case of a nonadiabatic transition through resonance. Relations are obtained (and plotted graphically) which allow the determination of the time of transverse relaxation. As an experimental verification of the method, the dependence of the transverse relaxation time on the concentration of paramagnetic ions was measured in aqueous solutions of copper sulphate and ferric nitrate. A.

539.153

5323. MEASUREMENT OF THE POLARIZABILITY OF METALLIC ATOMS WITH A FIELD EMISSION MICROSCOPE.
H.Liepack and M.Drechsler.
Naturwissenschaften, Vol. 43, No. 3, 52-3 (1956). In German.

A table of the measured polarizabilities is given and an empirical formula for its dependence on the applied potential and temperature. J.Hughes

539.153

5324. H.F.S. SEPARATIONS AND H.F.S. ANOMALY IN THE $6^2P_{3/2}$ METASTABLE LEVEL OF $Tl^{203}$ AND $Tl^{205}$. G.Gould.
Phys. Rev., Vol. 101, No. 6, 1828-9 (March 15, 1956).

The frequency of the h.f.s. was measured experimentally. The Breit-Rosenfeld effect is mainly responsible for the anomaly, although the Bohr-Weisskopf effect is also included in the analysis. G.E.Brown

539.153

5225. POLARIZABILITY OF $Mg^{+2}$ DERIVED FROM HYDROGEN-LIKE TERMS OF Mg II. K.Bockasten.
Phys. Rev., Vol. 102, No. 3, 729-30 (May 1, 1956).

It is shown that the two series $ng\ ^2G(n = 5\text{-}11)$ and $nh\ ^2H(n = 7\text{-}10)$ of Mg II, which were recently determined with great accuracy by Risberg, can be represented within the experimental errors by the polarization formula for nonpenetrating orbits, which contains as single adjustable parameter the polarizability $\alpha$ of the atom core. The value of $\alpha$ thus obtained for $Mg^{+2}$ is $(0.0720 \pm 0.0010) \times 10^{-24}$ cm$^3$. A.

539.153 : 537.561

5326. THE RELATIVISTIC THEORY OF THE SPECIFIC PRIMARY IONIZATION AND STOPPING POWER AND ITS APPLICATION IN HELIUM. H.S.Perlman.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 318-29 (April, 1956).

Using a relativistic Born approximation due to Bethe, an expression is derived for the collision cross-section of relativistic electrons with an atomic shell in terms of Schrödinger wave-functions. Then, by comparison with Møller's work for hydrogen, the stopping power and specific primary ionization are obtained as functions of a number of atomic parameters. These parameters are calculated for the case of helium and the results compared with experiment. A.

539.153 : 539.181

5327. MEASUREMENT OF THE f-VALUE OF THE Pb I RESONANCE LINE $\lambda = 2833$ A. H.D.Engler.
Z. Phys., Vol. 144, No. 4, 343-53 (1956). In German.

From absorption measurements with a beam of Pb atoms, the oscillator strength of the 2833 A line is found to be $0.60 \pm 0.10$. D.H.Whiffen

539.153.4 : 539.132

5328. GENERALIZED ANTISYMMETRIZED PRODUCT WAVE FUNCTIONS FOR ATOMS AND MOLECULES.
R.G.Parr, F.O.Ellison and P.G.Lykos.
J. chem. Phys., Vol. 24, No. 5, 1106 (May, 1956)

Theoretical. An n-electron wave function is written as an anti-symmetrized product of M functions, each a function of several electrons. Expressions for the energy of such a wave function are given, and the separation of "core" and "peel" wave functions is expressed in this language. J.Hawgood

539.153.4

5329. THE SOLUTION OF THE SCHRÖDINGER EQUATION FOR AN APPROXIMATE ATOMIC FIELD. T.Tietz.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 486-90 (Feb., 1956).

With a simple analytical approximation to the Fermi–Thomas field, eigenvalues and other properties of various atoms are calculated and compared with results from the self-consistent field treatment. G.E.Brown

539.153.4

5330. VARIATIONAL APPROACH TO THE QUADRUPOLE POLARIZABILITY OF IONS. T.P.Das and R.Bersohn.
Phys. Rev., Vol. 102, No. 3, 733-8 (May 1, 1956).

A variation method has been developed for treating the problem of polarization of electron shells of ions by external charges. The induced quadrupole moment has been calculated for a number of He-like ions and the two Ne-like ions $Al^{+++}$ and $Na^+$. For the former a shielding effect occurs, while for the latter a net antishielding effect is obtained in agreement with Sternheimer's conclusions. It is possible to compare the results of Steernheimer's numerical solution of the first-order Schrödinger equation with the variation method used here in the case of $Na^+$. Agreement is reasonably good. A.

539.153.4

5331. TABLES OF ATOMIC WAVE FUNCTIONS AND ENERGIES FOR LIGHT ELEMENTS. A.Tubis.
Phys. Rev., Vol. 102, No. 4, 1049-51 (May 15, 1956).

The atomic wave-function and variational energy tables of Morse, Young, and Haurwitz have been corrected and extended to include the lowest state configurations for isoelectronic sequences starting with $C^-$, $N^-$, $O^-$, and $F^-$. A.

539.154.2

5332. FUNDAMENTAL CONSIDERATIONS IN THE PERIODIC SYSTEM OF ELEMENTS. RELATIONS BETWEEN NUCLEUS AND ORBITAL ELECTRONS. S.K.Asunmaa and R.Lepsius.
Naturwissenschaften, Vol. 43, No. 7, 154 (1956). In German.

539.155

5333. STRUCTURE OF THE MASS INCREMENTS OF ISOTOPES. G.A.Baker, Jr and G.A.Baker, Sr.
Canad. J. Phys., Vol. 34, No. 5, 423-31 (May, 1956).

A simple, accurate formula for the atomic masses of all isotopes is developed on the basis of a simplified nuclear model. It is shown theoretically and empirically that a formula which is linear in A and whose coefficients depend only on $N - Z$ with a term added for pairing effects accounts for the major portion of the structure in the present experimental data and predicts them with unexcelled accuracy. A.

539.155

5334. ATOMIC MASSES FROM $C^{12}$ TO $Ne^{22}$. M.E.Kettner.
Phys. Rev., Vol. 102, No. 4, 1065-70 (May 15, 1956).

Doublets leading to mass values of the stable isotopes from $C^{12}$ to $Ne^{22}$ have been measured with a double-focusing mass seectrometer. In the determination of $C^{12}$, two new cycles have been used, $(\frac{1}{2}C_4H_4O{-}O^{18}O){-}(H_3O{-}HO^{18})$ and $(\frac{1}{2}C_4H_2O{-}O^{17}O) - (H_3O{-}H_2O^{17})$, resulting in the value $C^{12} = 12.003814 \pm 6$ a.m.u. An analysis of the available data pertinent to the investigated mass region is presented in an effort to uncover specific measurements most likely responsible for

the discrepancies in mass values reported from the various sources of investigation. It is found that a generally improved agreement is obtained if adjustments are made in the following reactions: $O^{18}(p, \alpha)N^{15}$, $F^{19}(d, \alpha)O^{17}$, $Ne^{21}(d, \alpha)F^{19}$ and $Ne^{20}(d, \alpha)F^{18}$. A.

539.155

5335. ATOMIC MASSES OF $H^1$, $D^2$, $C^{12}$ AND $S^{32}$. K.S.Quisenberry, T.T.Scolman and A.O.Nier. Phys. Rev., Vol. 102, No. 4, 1071-5 (May 15, 1956).

The large double-focusing mass spectrometer recently developed has been used to measure a series of 25 mass doublets. This instrument features a new peak-matching method of measurement which involves the presentation of a portion of the mass spectrum upon an oscilloscope. A group of consistency tests has been performed to prove the correctness of the mass dispersion formula used in calculating mass differences. The measured doublets are sufficient to calculate the mass of $C^{12}$ by five different cycles and also to calculate the masses of $H^1$, $D^2$ and $S^{32}$. The resulting mass values are $H^1 = 1.0081442 \pm 2$, $D^2 = 2.0147406 \pm 6$, $C^{12} = 12.0038167 \pm 8$, and $S^{32} = 31.9822401 \pm 9$ a.m.u., where the errors shown include the statistical standard error and the resistance calibration uncertainty. A discrepancy exists between the mass values determined here and some of those derived from nuclear reaction energy data. A.

539.155

5336. ATOMIC MASSES OF THE STABLE ISOTOPES, $10 \leq A \leq 30$. T.T.Scolman, K.S.Quisenberry and A.O.Nier. Phys. Rev., Vol. 102, No. 4, 1076-83 (May 15, 1956).

The masses of all stable isotopes in this range have been measured using the large double focusing mass spectrometer recently constructed. No serious discrepancies are found between the present results and other mass spectroscopic measurements except at $Ne^{20}$. The masses calculated from nuclear reaction energies are, with the exception of $F^{19}$, lower than the present results. The agreement between the Q-value masses and the present mass spectrometric results is not improved by changing the mass spectrometric secondary standard $C^{12}$ to agree with the Q-value result or by making the same percentage change in all mass doublet values. Neither is the agreement improved by a change in either the calibration of the nuclear spectrometers or the mass-energy conversion factor. Three Q-values which are inconsistent with other Q-values and also with the mass spectrometric results were eliminated from the nuclear reaction data and the Q-value masses recalculated. The new masses are in better agreement with the mass spectrometetric results, but are still, with the exception of $F^{19}$, lower than the present mass spectrometric values. A.

539.155.2 : 621.318.3

5337. AN ELECTROMAGNETIC ISOTOPE SEPARATOR. R.Bernas and C.Cassignol. Onde élect., Vol. 35, 1094-100 (Nov., 1955). In French.

A brief description of the theory and construction of a 60° sector instrument, for separating milligram quantities, is given. The types of ion sources used and the method of neutralization of space charge are detailed. J.Hughes (R)

## RADIOACTIVITY. $\alpha$-, $\beta$- AND $\gamma$-RAYS 539.16

539.16.08

5338. A COMPARISON OF RADIUM STANDARDS BY MEANS OF AN ADIABATIC MICROCALORIMETER WITH AUTOMATIC COMPENSATION. M.Lecoin and J.Robert. C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1718-20 (March 26, 1956). In French.

Five radium sources of strengths between 0.4 and 100 mc (determined by ionization chamber measurements) were compared calorimetrically. Although agreement between them was not better than 0.5% it is suggested that the method is capable of improvement. M.A.Grace

539.16.08 : 550.9

5339. DETERMINATION OF AGE BY CARBON 14 CONTENT. J.Labeyrie and G.Delibrias. J. Phys. Radium, Vol. 16, No. 12, 91S - 93S (Dec., 1955). In French.

Describes the construction and technique of a $CO_2$ gas method of dating. J.M.Hough

539.16.08

5340. ABSOLUTE STANDARDIZATION OF $\beta$-EMITTING NUCLIDES BY THE METHOD OF DEFINED SOLID ANGLE. B.Grinberg and Y.Le Gallic. J. Phys. Radium, Vol. 17, No. 3, 35A - 40A (March Suppl., 1956). In French.

By using a small solid angle ($\sim 2 \times 10^{-3}$) it is shown that many of the scattering corrections may be avoided. The method was applied to standardizing sources of $Co^{60}$, $S^{35}$, $I^{131}$ and $P^{32}$. Comparison with results obtained by other methods shows agreement to within the estimated error which decreases from 5% for $Co^{60}$ to 2½% for $P^{32}$. M.A.Grace

539.16.08 : 536.629

5341. A CALORIMETRIC METHOD OF DETERMINING THE ENERGY OUTPUT OF RADIOACTIVE MATERIALS. A.G.White. J. sci. Instrum., Vol. 33, No. 6, 230-4 (June, 1956).

A method of making a direct measurement of the rate of change of temperature with time is described. To do this a large capacity condenser and galvanometer are used in a circuit containing a thermistor as the temperature sensitive element. A description of two calorimeters embodying this principle, with which the energy outputs of radioactive samples may be determined, is given. The theoretical basis of the method is examined and means of estimating correction terms are suggested. A.

539.16.08 : 539.27 : 778.33

5342. ELECTRON MICROSCOPY AND RADIOAUTOGRAPHY AS COUPLED TECHNIQUES IN TRACER EXPERIMENTS. J.Liquier-Milward. Nature (London), Vol. 177, 619 (March 31, 1956).

The radioactive specimen is covered with a thin layer of photographic emulsion. The developed layer is isolated and examined in the electron microscope. R.Reed

539.16.08

5343. TISSUE-EQUIVALENT IONIZATION CHAMBERS. H.H.Rossi and G.Failla. Nucleonics, Vol. 14, No. 2, 32-7 (Feb., 1956).

Tissue-equivalent materials conforming to the formula $C_5H_{40}O_{18}N$, including a gel, plastic and filling gases have been employed in ionization chambers. Carbon replaces most of the oxygen in some of these substances. Construction techniques, including the moulding together of conducting and insulating plastics to obtain gas-tight seals, are described. Techniques for separating the contributions of fast and thermal neutrons and gamma radiation are outlined. L.R.Shepherd

539.16.08

5344. COUNTING SUSPENSIONS IN LIQUID SCINTILLATORS. F.N.Hayes, B.S.Rogers and W.H.Langham. Nucleonics, Vol. 14, No. 3, 48-51 (March, 1956).

A method of counting insoluble $\beta$-emitters. The preparations of samples containing $C^{14}$, $H^3$, $S^{35}$ or $Ca^{45}$ suitable for suspension in a solution of 4 g/1 2,5 diphenyloxazole and 0.05 g/1 1,4-di-[2-(5-phenyloxazolyl)]-benzene in toluene is described in detail. Effects of self-absorption, light absorption and settling out of suspension are considered. R.D Smith

539.16.08

5345. NITROUS OXIDE DOSIMETER FOR HIGH LEVELS OF BETAS, GAMMAS, AND THERMAL NEUTRONS. P.Harteck and S.Dondes.
Nucleonics, Vol. 14, No. 3, 66-72 (March, 1956).

The decomposition of $N_2O$ by ionizing radiations yields $N_2$, $O_2$ and $NO_2$ in the ratio 1 : 0.14 : 0.48 independent of temperature or pressure. The yield is exactly proportional to dosage up to $10^7$ r. Capsules containing $N_2O$ may be used as dosimeters, the pressure of $N_2$ and $O_2$ formed being measured after condensation of $N_2O$ and $NO_2$ in liquid $N_2$. For doses from $3 \times 10^7$ r to $3 \times 10^9$ r, $NO_2$ can be measured colorimetrically. Thermal neutrons may be detected by adding small amounts of $U^{235}$ to the capsule. The dosimeter may be used from $-80^\circ$C to $200^\circ$C. R.D.Smith

539.16.08

5346. RECENT DEVELOPMENTS IN GLASS DOSIMETRY. N.J.Kreidl and G.E.Blair.
Nucleonics, Vol. 14, No. 3, 82-3 (March, 1956)

Absorption change curves and fading characteristics for doses up to $10^7$ rep are given for a new dosimeter glass of composition, in mol.%: $SiO_2$—62.5, $Na_2O$—10.6, $B_2O_3$—20.8, $Al_2O_3$—6.0, $Co_3O_4$—0.1. The response is linear to $10^6$ rep. R.D.Smith

539.16.08

5347. $\alpha$-COUNTING AT LOW TEMPERATURE; A METHOD OF AVOIDING DIFFUSION OF RADON. E.Picciotto and F.Salvetti.
Nuovo Cimento (Ser. 10), Vol.3, No. 4, 815-19 (April, 1956). In French.

It is shown that considerable errors in the estimation of natural alpha-activity can arise from the neglect of diffusion of radioactive gases to the surface of the source. A method of avoiding these errors by measuring the activity at $-180^\circ$C with a scintillation counter is described. M.A.Grace

539.16.08

5348. TRITIUM SURVEY INSTRUMENTS. G.E.Driver.
Rev. sci. Instrum., Vol. 27, No. 5, 300-3 (May, 1956).

Portable counters for the detection of surface and air tritium contamination are described. The surface monitor uses a sponge rubber seal to the surface with an argon-methane counting mixture being admitted during measurements. The air monitor mixes methane with the air before counting, and is capable of detecting a tritium concentration of $10^{-5}$ mc/cm$^3$ of air. A.

539.163.1 : 539.172

5349. SHELL STRUCTURE EFFECTS ON SPONTANEOUS FISSION HALF-LIFE. R.E.Lingenfelter.
Phys. Rev., Vol. 101, No. 5, 1615-16 (March 1, 1956).

Analysis of current data on spontaneous fission half-lives of even-even nuclei suggests a sharp decrease in the half-life for N (neutron number) $\leq 140$, which might be attributed to the shell structure of the fragment nuclei; there is also an abrupt decrease, much sharper than is to be expected from the trend for $142 < N < 152$, for $N \geq 154$. A.O.Stanesby

539.163.1

5350. LONG-LIVED LEAD-205. J.R.Huizenga and J.Wing.
Phys. Rev., Vol. 102, No. 3, 926-7 (May 1, 1956).

Thallium L X-rays associated with L electron capture in $Pb^{205}$ were found in the decay products of normal Pb irradiated with 21 MeV deuterons. The estimated $\frac{1}{2}$-life of $Pb^{205}$ for L electron capture is about $5 \times 10^7$ yrs. A.O.Stanesby

539.163.1 : 537.542

MEASUREMENT OF THE HALF-LIFE OF RADON WITH A CURIE-TYPE IONIZATION CHAMBER. See Abstr. 4462

539.163.2

5351. $^{160}$Tb DECAY. G.Bertolini, M.Bettoni and E.Lazzarini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 754-63 (April, 1956).

By means of an intermediate $\beta$ spectrometer and a scintillation spectrometer, the decay of $Tb^{160}$ has been studied. Coincidences between $\beta^-$ continuous spectrum and selected $\gamma$-rays allows the resolution of the $\beta^-$ spectra of low energy. $\beta^-$ spectra of $367 \pm 12$, $564 \pm 6.5$, $861 \pm 1.8$, and $1711 \pm 7$ keV have been resolved. From their photospectrum relative intensities of $\gamma$-rays have been taken. Conversion coefficients of some $\gamma$-rays have been obtained. A decay scheme is suggested The possibility of the rotational character of some of the excited levels, predicted by the Bohr–Mottelson theory, is discussed. A.

539.163.2

5352. THE DECAY OF $^{58}$Co AND $^{57}$Co. M.A.Grace, G.A.Jones and J.O.Newton.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 363-9 (April, 1956).

The single channel $Co^{58}$ gamma-ray spectrum and the spectrum in coincidence with K-X-rays have been studied with scintillation counters and a proportional counter and show no evidence for radiation other than the well-established 805 keV gamma-ray. The results accord well with the decay scheme of Deutsch and Elliott. An upper limit of $2.5 \times 10^{-3}$ per disintegration was set on the intensity of 29 keV gamma-radiation which, according to a recent suggestion, follows the decay of $Co^{57}$. A.

539.163.2 : 539.155.4

5353. MASS ASSIGNMENT OF THE 44-MINUTE CALIFORNIUM-245 AND THE NEW ISOTOPE CALIFORNIUM-244. A.Chetham-Strode, Jr, G.R.Choppin and B.G.Harvey.
Phys. Rev., Vol. 102, No. 3, 747-8 (May 1, 1956).

The 44-minute californium alpha emitter previously thought to be $Cf^{244}$ has been reassigned to mass number 245 on the basis of milking experiments, excitation functions, cross bombardments, and decay-scheme studies. $Cf^{245}$ decays by the emission of $(7.11 \pm 0.02)$ MeV alpha-particles ($\sim 30\%$) and by orbital electron capture ($\sim 70\%$). The new isotope $Cf^{244}$ was also identified and found to decay by the emission of $(7.17 \pm 0.02)$ MeV alpha-particles with a half-life of $25 \pm 3$ minutes. The mass assignment of this isotope was established by its genetic relationship to $Cm^{240}$ and by the excitation function for its formation by the $(\alpha, 4n)$ reaction on $Cm^{244}$. A.

539.163.2

5354. ELECTRON CAPTURE AND ALPHA DECAY OF $Np^{235}$. R.W.Hoff, J.L.Olsen and L.G.Mann.
Phys. Rev., Vol. 102, No. 3, 805-7 (May 1, 1956).

An L/K capture ratio of $30 \pm 2$ was found from absolute L and K X-ray measurements. No gamma-rays are observed in the electron capture decay of $Np^{235}$. An alpha branching ratio of $(3.5 \pm 0.4) \times 10^{-5}$ was measured for this nuclide. The alpha-particles have coincident 26 and 85 keV gamma-rays with an intensity of $0.054 \pm 0.005$ gamma per alpha disintegration for the 85 keV gamma-ray. The intensity of the 26 keV gamma-ray is comparable, although somewhat more uncertain. A.

539.163.2

5355. DECAY OF $Sb^{125}$. N.H.Lazar.
Phys. Rev., Vol. 102, No. 4, 1058-62 (May 15, 1956).

Eleven gamma-rays between 0.100 and 0.637 MeV have been identified in the decay of $Sb^{125}$. From their relative intensities as measured with a sodium iodide crystal 3 inches in diameter and 3 inches high, and with the assistance of coincidence spectrometry, a decay scheme may be constructed which is consistent with all the data. The half-life for $Sb^{125}$ was determined as $2.0 \pm 0.2$ years. A.

539.163.2

5356. AN INVESTIGATION OF CHAINS OF RADIOACTIVE TRANSITIONS. V.S Shpinel' and G.A.Kuznetsova.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 231-42 (1956). In Russian.

A spectroscopic investigation of radioactive transitions $Zr^{97} \rightarrow Nb^{97} \rightarrow Mo^{97}$; $Ru^{97} \rightarrow Tc^{97}$; $Ru^{105} \rightarrow Rh^{105} \rightarrow Pd^{105}$ and $Ru^{103} \rightarrow Rh^{103}$ was carried out by means of a $\beta$-spectrometer with two magnetic lenses and a NaI(Tl) scintillation $\gamma$-spectrometer. As a whole the results agree with the published decay schemes, an exception being a $\beta$-spectrum with $E \cong 0.48$ MeV and intensity of 15%, and hard 2.2 and 1.6 MeV $\gamma$-rays found from a $Zr^{97} + Nb^{97}$ source. 80 keV $\gamma$-rays have been detected from $Rh^{105}$. Corresponding $\beta$- and $\gamma$-transitions have been found in odd nuclei differing by two neutrons. A.

539.164 : 537.542

THE DESIGN OF A MULTIPLE WIRE PROPORTIONAL COUNTER AND ITS USE IN THE STUDY OF THE $\alpha$-PARTICLES FROM THE REACTION $^7Li + p$. See Abstr. 4460

539.165

5357. STUDY OF THE SHAPES OF THE $\beta$-SPECTRA AND DETERMINATION OF THE NUCLEAR LEVEL SCHEMES IN THE CASES OF $Br_{35}^{80}$, $Rb_{37}^{86}$ AND $Rh_{45}^{105}$. J.Laberrigue-Frolow.
Ann. Phys. (Paris) (Sér. 13), Vol. 1, 152-206 (Jan.-Feb., 1956). In French.

Measurements were made on the $\beta^-$- and $\beta$-$\gamma$-coincidence spectra. Bibliography of 115 references. A.O.Stanesby

539.165

5358. USE OF $\beta^-$-PARTICLE ABSORPTION CURVES FOR ENERGY DETERMINATION OF THESE PARTICLES AND THE IDENTIFICATION OF CERTAIN RADIOACTIVE SUBSTANCES. M.Perey and C.Baltzinger.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1446-9 (March 12, 1956). In French.

The ½-thickness $A_{1/2}$ in Cu absorbers over the range of 20-2% of initial intensity is, for simple $\beta^-$-spectra, related to the max. energy: $E_{max} = [A_{1/2}(g.cm^{-2}\ Cu) + 0.014]/0.044$ MeV for $1 < E < 3$ MeV. A.O.Stanesby

539.165

5359. SEARCH FOR DOUBLE $\beta$ DECAY IN $Cd^{116}$. J.F.Detœuf and R.Moch.
J. Phys. Radium, Vol. 16, No. 12, 897-901 (Dec., 1955). In French.

Double beta decay was looked for with a coincidence arrangement of a pair of scintillation counters whose output signals were displayed on an oscilloscope and photographed. Comparison was made between a source of $Cd^{116}$, in which double $\beta$-decay is expected, and a source of stable $Cd^{114}$. From the absence of a significant excess of coincidences in $Cd^{116}$ it is concluded that the mean life for double $\beta$-decay without neutrino emission is greater than $0.6 \times 10^{17}$ years. M.A.Grace

539.165 : 539.152.1

5360. ENERGY LEVELS OF $Pu^{239}$ POPULATED BY THE BETA DECAY OF $Np^{239}$. J.M.Hollander, W.G.Smith and J.W.Mihelich.
Phys. Rev., Vol. 102, No. 3, 740-6 (May 1, 1956).

The conversion electron spectrum arising from the beta decay of 2.3 day $Np^{239}$ has been studied with three 180° permanent-magnet photographic spectrographs. The following transitions, with multipolarities where known, were observed (energy in keV): 44.64 (M1 + E2), 49.40 (M1 + E2), 57.25 (E2), 61.4 (E1), 67.82 (E2), 106.1 (E1), 106.4, 181.8, 209.9 (M1), 226.4, 228.4 (M1), 254.6, 273.1, 277.7 (M1), 285.6, 316.1, and 334.5. Gamma–gamma coincidence experiments have also been performed. It is necessary in order to account for the present data to modify the previously accepted level scheme for $Pu^{239}$; a revised scheme is presented, with spin and relative parity assignments. The energy and intensity data are discussed in terms of the Bohr–Mottelson unified nuclear model. A rough measurement of the Auger coefficient in Z = 94 is reported, and also an experimental value for the K-electron binding energy in plutonium is given. A.

539.165

5361. ON THE ANGULAR DISTRIBUTION OF $\beta$-RADIATION. G.R.Khutsishvili.
Zh. éksper. teor. Fiz., Vol. 25, No. 6 (12), 763-4 (1953). In Russian.

539.165

5362. ON THE ANGULAR DISTRIBUTION OF $\beta$-RADIATION. II. G.R.Khutsishvili.
Zh. éksper. teor. Fiz., Vol. 28, No. 3, 370-1 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 2, 376 (Sept., 1955).

An expression is given for the distribution of $\beta$-radiation as a function of angle and energy for the transition $\Delta I = \pm 2$, yes, in which Coulomb effects are included. J.Hughes

539.165

5363. THE ELECTRON SPECTRUM OF $U^{237}$. S.A.Baranov and K.N.Shlyagin.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 225-30 (1956). In Russian.

The electron spectrum of $U^{237}$ for energies above 1 keV was investigated on a $\pi\sqrt{2}$ focusing-angle magnetic $\beta$-spectrometer. Two $\beta$-spectrum components with boundary energies 84 keV (26%) and 249 keV (74%) were determined. The following $\gamma$ transitions for $Np^{237}$ were computed from the conversion electron lines: 26, 33, 43, 60, 69 (?), 101 (?), 124 (?), 165, 193 (?), 208, 267, 331, 370 and 436 keV. A tentative decay scheme of $U^{237}$ is presented. A.

539.165.2

5364. STUDIES OF SEVERAL ORBITAL CAPTURES. P.Avignon.
Ann. Phys. (Paris) (Sér. 13), Vol. 1, 10-56 (Jan.-Feb., 1956). In French.

A detailed description is given of the investigation of the nuclides $Zn^{65}$, $Pd^{103}$, $Sn^{113}$ and $Rh^{102}$ using scintillation and proportional counters and a magnetic-lens spectrometer. 99 refs. J.Hughes

539.165.2

5365. CONTRIBUTION TO THE STUDY OF NUCLEAR DISINTEGRATION BY ELECTRON CAPTURE. THE CASES OF $Ba^{133}$ AND $Ge^{71}$. M Langevin.
Ann. Phys. (Paris) (Sér. 13), Vol. 1, 57-98 (Jan.-Feb., 1956). In French.

A detailed account is given of the application of scintillation and proportional counter spectrometry to these decay schemes. A decay scheme is deduced for $Ba^{133}$, which decays mainly by L capture. The total disintegration energy of $Ge^{71}$ was found to be 226 keV, and the ratio of L capture to K capture $0.30 \pm 0.02$, considerably greater than the theoretical value of 0.1. 55 refs. J.Hughes

539.165.2

5366. NUCLEAR MATRIX ELEMENTS FOR ALLOWED $\beta$ TRANSITIONS. W.C.Grayson, Jr and L.W.Nordheim.
Phys. Rev., Vol. 102, No. 4, 1084-92 (May 15, 1956).

Nuclear matrix elements are evaluated for all allowed $\beta$-transitions in the strict j-j coupling shell model, i.e., for states of lowest seniority. The wave-functions for the $j^N$ configurations are obtained by algebraic means in the formalism of coefficients of fractional parentage. The matrix elements are given for the two assumptions, firstly that isotopic spin is a good quantum number, and secondly that the neutrons and protons are coupled separately to their lowest seniority states. The latter includes the case where the protons end in

a $j = l + \frac{1}{2}$ shell, while the neutrons end in the $j = l - \frac{1}{2}$ shell. A similar explicit form is given for the magnetic moments of the states of the $j^N$ configuration with seniority one. A.

539.165.2

5367. UNFAVORED FACTORS FOR ALLOWED $\beta$ TRANSITIONS. W.C.Grayson, Jr and L.W.Nordheim.
Phys. Rev., Vol. 102, No. 4, 1093-7 (May 15, 1956).

Unfavoured factors U, that is, ratios of computed-to-observed transition probabilities, are tabulated in a systematic manner for allowed $\beta$-transitions in the strict j-j coupling scheme. The introduction of many-particle wave-functions lowers the gap between favoured and unfavoured transitions, but does not eliminate it. The systematics brings out clearly the role of configuration interaction through a strong correlation between the U factors and the expected purity of the shell-model wave-functions. The matrix elements for even-A nuclei are on the average larger than those for odd-A nuclei and thus explain without any new hypothesis the lower average ft values for the even-A group. A.

539.166

5368. DETERMINATION OF $\gamma$-TRANSITIONS IN THE REACTION $Ne^{20}(d, p)\ Ne^{21*} \rightarrow (\gamma)Ne^{21}$. S.Gorodetzky, T.Muller and M.Port.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1281-4 (March 5, 1956). In French.

Levels were found in $Ne^{21}$ at 0.350, 1.73 and 2.80 MeV.
A.O.Stanesby

539.166

5369. ON THE EXCITED STATES OF $_{63}Eu^{153}$. N.Marty and M.Vergnes.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1438-40 (March 12, 1956). In French.

Measurements on the $\beta$- and $\gamma$- and $\beta$-$\gamma$- and $\gamma$-$\gamma$-coincidence spectra provided evidence for an electric dipole ($\alpha_K = 0.3 \pm 0.1$) radiation of energy $98 \pm 0.5$ keV and intensity comparable with that of the 103 keV $\gamma$-radiation.
A.O.Stanesby

539.166

5370. SHORT-LIVED ISOMERIC STATE IN $UX_2(Pa^{234})$. H.Vartapetian and L.Dick.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1602-4 (March 19, 1956). In French.

Delayed coincidence measurements using NaI scintillation counters gave a $\frac{1}{2}$-life for the 93 keV level of $(1.8 \pm 0.3) \times 10^{-9}$ sec.
A.O.Stanesby

539.166

5371. GAMMA–GAMMA ANGULAR CORRELATION IN $^{46}Ti$. G.Bertolini, M.Bettoni and E.Lazzarini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 800-5 (April, 1956).

The directional angular correlation of the $\gamma$-$\gamma$ cascade of the $Ti^{46}$, obtained from $Sc^{46}$ is studied. The correlation function is represented by the formula: $W(\theta) = 1 + 0.1006P_2(\cos\theta) + 0.0178P_4(\cos\theta)$. A.

539.166

5372. ANGULAR CORRELATION OF GAMMA RAYS IN $Pb^{204m}$. J.R.Huizenga, V.E.Krohn and S.Raboy.
Phys. Rev., Vol. 102, No. 4, 1063-5 (May 15, 1956).

The anisotropies of the three pairs of gamma-rays in the triple cascade of 1.1 hr $Pb^{204m}$ have been measured. The results were $0.163 \pm 0.010$ for the 374-899 keV (prompt) pair; $0.414 \pm 0.015$ for the 913-899 keV pair; and $0.398 \pm 0.011$ for the 913-374 keV pair. These results are consistent with the scheme, 9(E5)4(E2)2(E2)0. A.

539.166.74

5373. THE COMPTON EFFECT AT HIGH ENERGIES. A.A.Abrikosov.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 386-98 (1956). In Russian.

Analysis of effects obtained by summation of diagrams having, for a given power of $e^2$, a maximum power of $\ln(\omega/m)$ which corresponds to $[e^2\ln^2(\omega/m)]^n$; here e and m = charge and mass of electron, $\omega$ = energy of photon. The following results were obtained: Formulae for single and multiple effects; angular and energy distribution of the secondary quanta; probability of secondary electron possessing a given energy. A peculiar variation of scattering at small angles has been found which leads to variation of the refractive index of the medium for energetic photons. A.

539.166.75

5374. THE RESONANT ABSORPTION OF $\gamma$-RAYS BY $N^{14}$. G.M.Griffiths.
Canad. J. Phys., Vol. 34, No. 3, 339-40 (March, 1956).

A nitrogen-filled proportional counter was irradiated with 8.06 MeV $\gamma$-rays from the $C^{13}(p, \gamma)N^{14}$ reaction (554 keV proton-capture resonance). The pulse-height spectrum obtained corresponded to a monochromatic, 554 keV proton group ascribed to the inverse resonant $N^{14}(\gamma, p)C^{13}$ reaction. The absence of peaks in the spectra obtained using 6, 12 or 17 MeV incident $\gamma$-rays confirmed this interpretation. J.J.Wilkins

539.166.83

5375. DETERMINATION OF THE RATIOS OF INTERNAL CONVERSION COEFFICIENTS FOR THE $In^{114}$ ISOMERIC TRANSITION. V.M.Kel'man, R.Ya.Metskhvarishvili, V.A.Romanov, L.I.Rusinov and K.S.Konoplev.
Dokl. Akad. Nauk. SSSR, Vol. 107, No. 3, 394-7 (1956). In Russian.

Measurements for the 192 keV transition were carried out with a $\beta$-ray spectrometer. The various ratios of K, L, M and N intensities, as well as $L_I : L_{II} : L_{III}$ are defined to a few percent, and indicate that the transition is E4.
G.E.Brown

539.166.83

5376. ELECTRON SCATTERING IN THE K-ELECTRON — GAMMA ANGULAR CORRELATION IN $Sn^{117}$. R.K.Golden and S.Frankel.
Phys. Rev., Vol. 102, No. 4, 1053-7 (May 15, 1956).

From directional correlation measurements using sources of various thicknesses, the angular correlation coefficient, $b_2A_2$, for the K electron–gamma cascade in $Sn^{117}$ is found to be $-0.143 \pm 0.011$. This requires a mixture of $(0.15^{+0.15}_{-0.10})$ % E2 in the predominantly M1 $\frac{3}{2} \rightarrow \frac{1}{2}$ transition. The sign of the mixture ratio is positive. The theory describing the reduction of the angular correlation coefficient as the result of multiple elastic scattering in the source is shown to be valid for rather thick sources where even inelastic scattering is appreciable. A.

## NUCLEAR REACTIONS 539.17

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172.11 : 537.534.74

INELASTIC SCATTERING OF 42-MeV $\alpha$'S BY Mg. See Abstr. 4456

539.172.13 : 539.152.1

5377. COULOMB EXCITATION OF THE ISOTOPES OF MERCURY. R.Barloutaud, T.Grjebine and M.Riou.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1284-7 (March 5, 1956). In French.

Using protons, Coulomb excitation of enriched isotopes of mercury enabled a determination to be made of the reduced probability of excitation for the first levels of $Hg^{198}$, $Hg^{200}$, $Hg^{202}$ and the first two of $Hg^{199}$. J.Hughes

539.172.13

5378. $O^{18}(p, n)F^{18}$ REACTION AND LEVELS OF FLUORINE 18. V.Naggiar, M.Roclawski-Conjeaud, D.Szteinsznaider and J.Thirion.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1443-6 (March 12, 1956). In French.

Levels of $F^{18}$ have been located by observation of slow neutron thresholds in the $O^{18}(p, n)F^{18}$ reaction. Levels at $960 \pm 10$, $1065 \pm 15$, and possibly $1245 \pm 10$ keV excitation are reported. J.J.Wilkins

539.172.13

5379. ON THE APPLICABILITY OF FERMI'S FORMULA FOR DESCRIBING THE POLARIZATION OF FAST NUCLEONS IN SCATTERING BY NUCLEI. I.I.Levintov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 2, 240-3 (1956). In Russian.

Fermi's formula for the polarization of complex nuclei does not depend on Born approximation being valid, but only on the spin-orbit contribution to the phase being small. Parameters are fitted to experiment in the energy region 130-315 MeV. G.E.Brown

539.172.13

5380. PRECISION MEASUREMENT OF SOME PROTON RESONANCES OF LIGHT NUCLEI. F.Bumiller, H.H.Staub and H.E.Weaver.
Helv. phys. Acta, Vol. 29, No. 1, 83-101 (1956). In German.

Proton resonance energies of the reactions $Li^7(p, \gamma)$ at 441 kV, $F^{19}(p, \alpha, \gamma)$ at 340 and 871 kV and $Al^{27}(p, \gamma)$ at 991 kV have been measured on an absolute scale with a $180^0$ single focusing magnetic spectrometer. The results were obtained in terms of the two atomic constants $\gamma_p$, the gyromagnetic ratio of the proton and $\nu_C/\nu_K$ the ratio of cyclotron to spin-resonance frequency of the proton. Using for these two quantities the values recently determined by the group at the Bureau of Standards the following values for the resonance energies are obtained in absolute kilovolts: $Li^7(p, \gamma)$: $441.2 \pm 0.6$; $F^{19}(p, \alpha, \gamma)$: $340.5 \pm 0.3$; $F^{19}(p, \alpha, \gamma)$: $871.3 \pm 0.4$; $Al^{27}(p, \gamma)$: $990.8 \pm 0.2$. While the two first values agree very well with those obtained by various workers by absolute electrostatic deflection, the two latter values are significantly lower than those obtained by the Wisconsin group. A.

539.172.13

5381. $^8$Li EMISSION FROM PROTON INDUCED DISINTEGRATIONS AT 950 MeV. B.A.Munir.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 355-62 (April, 1956).

G5 plates exposed to 950 MeV protons were scanned and fifty $Li^8$ "Hammer stars" discovered. They were divided into stars representing light and heavy nuclei disintegrations. In the case of light element stars the energy and angular distributions of the $Li^8$ fragment indicate that it is the residual nucleus after a light element breakup. For heavy nuclei stars the mechanisms of direct knock-on and evaporation can be excluded. The simplest hypothesis is that the fragments are ejected as part of the cascade process. A.

539.172.13 : 539.155.4

5382. MASS OF $B^{13}$ FROM THE NUCLEAR REACTION $Li^7(Li^7, p)B^{13}$. S.K.Allison, P.G.Murphy and E.Norbeck, Jr.
Phys. Rev., Vol. 102, No. 4, 1182-3 (May 15, 1956).

A beam of Li ions ($\frac{1}{2} - 1$ $\mu$A), accelerated to $1.61 \pm 0.02$ MeV in a Van de Graaff machine, was used to bombard a Li target. Identification of the protons attributed to this reaction leads to a Q value of $5.97 \pm 0.03$ MeV, and a value for $(M - A)$ of $20.39 \pm 0.03$ MeV. M.A Grace

539.172.13

5383. A MEASUREMENT OF THE AVERAGE NUMBER OF NEUTRONS PER FISSION FROM URANIUM AND BISMUTH WHEN BOMBARDED WITH 147 MeV PROTONS. G.N.Harding.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 330-4 (April, 1956).

A direct measurement has been made by a coincidence method. Taking the figure for the average number of neutrons per thermal neutron fission of $U^{235}$ to be $2.5 \pm 0.1$, the results obtained are $13.1 \pm 1.6$ for uranium and $10.0 \pm 2.7$ for bismuth. A.

539.172.13

5384. THE ENERGY LEVELS OF $^{26}$Al. L.L.Green, J.J.Singh and J.C.Willmott.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 335-44 (April, 1956).

The $Mg^{25}(p, \gamma)Al^{26}$ reaction has been studied at six resonances in the region of 675 keV to 960 keV. New levels have been located at 2.32 MeV, 3.16 MeV, 3.76 MeV and 4.55 MeV, and the level at 2.09 MeV is shown to be a close doublet. Spins and parities have been assigned on the basis of angular distribution measurements. The resonances are shown to be reasonably pure isotopic spin states with the main transitions being E1 transitions satisfying the isotopic spin selection rules. A.

539.172.13 : 537.534.74

INELASTIC SCATTERING OF 18 MeV PROTONS BY $Mg^{24}$. See Abstr. 4457

539.172.13

5385. DIFFRACTION SCATTERING OF FAST DEUTERONS BY NUCLEI. A.I.Akhiezer and A.G.Sitenko.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 3, 385-8 (1956). In Russian.

The cross-section for this is calculated on the assumption that if the proton or neutron hit the (completely "black") nucleus, they are absorbed. In addition to this process, dissociation of the deuteron coming from the small change in momentum produced in diffraction scattering is considered and the cross-section calculated. G.E.Brown

539.172.13

5386. CALCULATION OF REDUCED WIDTHS FROM STRIPPING CROSS-SECTIONS. W.Tobocman.
Phys. Rev, Vol. 102, No. 2, 588-9 (April 15, 1956).

A theoretical check of Bowcock's (Abstr. 6460/1955) correction of the Butler theory of stripping in two cases (14.3 and 3.6 MeV deuterons on $F^{19}$). In neither case is the result satisfactory. A.O.Stanesby

539.172.13

5387. DIFFRACTION SPLITTING OF FAST NON-RELATIVISTIC DEUTERONS. A.I.Aliev and E.L.Feĭnberg.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 115-25 (1956). In Russian.

Diffraction splitting has been computed for deuterons with energies of the order of 100 MeV interacting with nuclei whose dimensions greatly exceed those of the deuteron. It is shown that the total cross-section for this process is of the same order of magnitude as the stripping cross-section. The angular as well as energy distributions of protons and neutrons in the correlated neutron–proton pairs are approximately the same as those for stripping when either a neutron or a proton is emitted. The formulae are strictly valid for a fraction of the processes, namely, for those in which only a small amount of momentum is transferred to the nucleus; this is due to uncertainty concerning three circumstances: (a) the structure of the nuclear edge, (b) the nuclear transparency with respect to fast neutrons, and (c) the behaviour of the deuteron wave function at small distances between the neutron and proton.

Only a rough estimate of the total cross-section obtained by extrapolation is given. Thus the angular and energy spectra for diffraction splitting are different from those for electrical splitting. The diffraction splitting cross-section is independent of energy and increases as $A^{\frac{1}{3}}$. A.

539.172.13 : 539.185.08

CROSS-SECTION OF A NUCLEAR REACTION WITH NEUTRON EMISSION, BY PHOTOGRAPHIC METHOD. See Abstr. 4677.

539.172.13

5388. RELATIVE CROSS-SECTIONS FOR DISINTEGRATION OF LIGHT ELEMENTS BY TRITONS. D.Magnac-Valette.
J. Phys. Radium, Vol. 16, No. 12, 135S - 136S (Dec., 1955). In French.

A short account of nuclear emulsion studies of the reactions induced by 3.8 MeV tritons in $Li^6$, $Li^7$, $C^{12}$, $N^{14}$ and $O^{16}$. M.A.Grace

539.172.3

5389. PHOTODISINTEGRATION OF $^{16}O$ AND $^{63}Cu$ BY PHOTONS OF VARIABLE ENERGY. J.G.Campbell.
Austral. J. Phys., Vol. 8, No. 4, 449-55 (Dec., 1955).

Proton-capture reactions in light nuclei provide $\gamma$-radiation with energy controllable by variation of proton energy. The radiation from proton capture by $Li^7$ has been used to investigate the $(\gamma, n)$ reactions in $O^{16}$ and $Cu^{63}$ over an energy range of 300 keV around 17.7 MeV. No resonant behaviour was observed in $O^{16}$. A variation in the $Cu^{63}$ photoneutron cross-section is interpreted as the combined effect of many unresolved levels. A.

539.172.3

5390. PHOTOPROTONS FROM FLUORINE. W.B.Lasich, E.G.Muirhead and G.G.Shute.
Austral. J. Phys., Vol. 8, No. 4, 456-67 (Dec., 1955).

The energy and angular distributions of protons produced in the $F^{19}$ $(\gamma, p)$ reaction have been obtained for the photon energy range 10-16.5 MeV. An integrated cross-section of 18 MeV mbarn was obtained for this region. The angular distribution was found to be of the form $(a + b \sin^2 \theta)$ with the ratio b/a strongly energy dependent. The higher-energy protons show evidence of an independent particle-type interaction which is in plausible agreement with the shell-model structure of fluorine. The range–energy relation for the target gas, $CF_4$, is presented in an Appendix. A.

539.172.3

5391. EVAPORATION AND NUCLEAR TEMPERATURE, PRELIMINARY RESULTS OF THE STUDY OF THE PHOTOPROTON SPECTRUM FROM THE Cu$(\gamma, p)$ Ni REACTION WITH THE AID OF A SPECTRUM OF MONOCHROMATIC RAYS.
R.Chastel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1440-3 (March 12, 1956). In French.

The photoproton spectrum from copper irradiated with lithium (14.8 and 17.6 MeV) $\gamma$-rays has been measured using nuclear emulsions. The spectrum is consistent with a nuclear temperature $1.0 \pm 0.1$ MeV, and indicates no significant contribution from the direct photonuclear effect. J.J Wilkins

539.172.3

5392. $(\gamma, \alpha)$ PROCESS ON MEDIUM AND HEAVY ELEMENTS. F.Heinrich, H.Wäffler and M.Walter.
Helv. phys. Acta, Vol. 29, No. 1, 3-36 (1956). In German.

Integral $(\gamma, \alpha)$-yields due to 31 MeV bremsstrahlung are presented for $V^{51}$, $Ge^{73}$, $In^{115}$, $Sb^{121}$, $Tl^{203}$. The experimental ratios of the $(\gamma, \alpha)$- to $(\gamma, n)$-yields have been determined for these nuclei. The same ratios are also computed from the statistical theory of nuclear reactions. They are in good agreement with the experiment. The differential excitation curves for the $(\gamma, \alpha)$-reactions on $Cu^{65}$, $Br^{81}$, $Rb^{87}$, as measured by Haslam, Katz and others, and $Ag^{109}$, measured by De Laboulaye and Beydon have been calculated from the statistical theory. The agreement between the experimental and theoretical curves is satisfactory. A.

539.172.3

5393. POLARIZATION OF NUCLEONS FROM PHOTONUCLEAR REACTIONS. W.Czyż and J.Sawicki.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 864-9 (May, 1956).

A method is given to calculate the polarization of nucleons produced in photonuclear reactions if the photonucleon is assumed to interact with the residual nucleus through a potential containing in general a spin-orbit coupling. The method is applied to the $Be^9(\gamma, n)Be^8$ reaction where for the $Be^9$ nucleus the one particle model is assumed with the central interactions of Guth and Mullin. The maximum polarization $P_{max} \sim 45\%$ results for $\hbar\omega = 2$ MeV at the scattering angle $\theta \sim 45°$. The dependence of P on $\theta$ is shown graphically for some energies $\hbar\omega$ near the threshold of the reaction. The polarization of photonucleons from a nucleus being in a $S_{1/2}$ ground state is discussed. Further applications of the method and the results are indicated. A.

539.172.4

5394. THE INELASTIC SCATTERING OF 2.5 MeV NEUTRONS BY CHROMIUM, MANGANESE AND VANADIUM. L.E.Beghian, D.Hicks and B.Milman.
Phil. Mag. (Ser. 8), Vol. 1, No. 3, 261-8 (March, 1956).

Both gamma-rays and inelastically scattered neutrons were experimentally observed. The following levels were identified: Chromium 1.44 ± 0.03 MeV, Manganese 0.126 ± 0.005 MeV, 0.98 ± 0.05 MeV, 1.34 ± 0.05 MeV, 1.65 ± 0.05 MeV 2.40 ± 0.05 MeV; Vanadium 0.32 ± 0.02 MeV, 0.92 ± 0.04 MeV, 1.62 ± 0.04 MeV, 1.83 ± 0.04 MeV. The decay scheme of the levels excited in $Mn^{55}$ was investigated by the method of gamma–gamma coincidences, and it was shown that the higher energy states decay by cascade via the 0.126 MeV level. A.

539.172.4

5395. NEUTRON CROSS-SECTION MEASUREMENTS OF ANTIMONY, GALLIUM, CADMIUM, AND MERCURY.
R.R.Palmer and L.M.Bollinger.
Phys. Rev., Vol. 102, No. 1, 228-36 (April 1, 1956).

The results of neutron transmission measurements on antimony, gallium, cadmium, and mercury, and on their separated isotopes are presented. Several methods are described for finding resonance parameters from neutron transmission measurements. Level parameters are reported for six resonances of $Sb^{121}$; four of $Sb^{123}$; three for $Ga^{69}$; four for $Ga^{71}$; and one each for $Cd^{110}$ and $Cd^{111}$. Isotopic assignments are made for three resonances in mercury. A.

539.172.4

5396. EXCITATION OF COLLECTIVE LEVELS OF HEAVY NUCLEI BY NEUTRONS. D.F.Zaretskiĭ and A.V.Shut'ko.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 141-8 (1956). In Russian.

Inelastic neutron scattering on target nucleus collective levels not accompanied by compound nucleus formation is calculated by perturbation theory methods in accordance with the Bohr and Mottelson model representation. A.

539.172.4

5397. HEAT TRANSFER IN REACTORS COOLED AND MODERATED BY WATER. M.Altman.
Nucleonics, Vol. 14, No. 2, 66, 68-73 (Feb., 1956).

Small temperature differences between fuel element surfaces and coolant can be achieved either by high flow rates or by surface boiling. If surface boiling occurs mass flow rates may be lowered by 30% and the pressure drop across the core by 40%. Ejection of the steam-water mixture from a coolant

channel ("Vapour-binding") or formation of a steam-blanket round part of a fuel element is liable to occur as a result of reactor transients. Conditions under which stable boiling can be achieved without risk of damage to fuel elements are discussed. R.D.Smith

539.172.4

5398. SMALL GAS-CYCLE REACTOR OFFERS ECONOMIC PROMISE. F.Daniels.
Nucleonics, Vol. 14, No. 3, 34-41 (March, 1956).

The design of a 20 MW helium-cooled graphite moderated reactor operating a 5 MW gas turbine is considered in detail. The core, 6 ft in diameter and 5 ft 5 in. high, is an assembly of perforated graphite blocks. It contains 13.7 kg $U^{235}$ in the form of $UC_2$ (10% $U^{235}$) powder or pellets in graphite cartridges. Control rods are B or $B_4C$ in Mo cans. Helium at 225 lb/in$^2$ and 1350$^0$ F, from the reactor, operates the turbine via a heat exchanger. The preparation and processing of the fuel are considered. The reactor has good neutron economy and should be inherently safe. R.D.Smith

539.172.4

5399. PROGRESS ON MATERIALS— KEY TO GAS-CYCLE REACTOR POTENTIAL.
Nucleonics, Vol. 14, No. 3, 42-4 (March, 1956).

A brief review of present ideas on gas-cooled power reactors, including comparison data for four proposed systems with electrical outputs up to 60 MW. These reactors have high efficiency and require relatively little space. R.D.Smith

539.172.4

5400. USING INTERMEDIATE EXPERIMENTS FOR REACTOR NUCLEAR DESIGN. W.H.McCorkle.
Nucleonics, Vol. 14, No. 3, 54-6 (March, 1956).

General principles of exponential assemblies, effects of harmonics on flux distribution and extrapolation of results to full size reactors are considered. R.D.Smith

539.172.4

5401. CONDUCTING AN EXPONENTIAL EXPERIMENT WITH A NATURAL-U GRAPHITE LATTICE. H.Dopchie, F.Leonard, M.Neve de Mevergnies and G.Tavernier.
Nucleonics, Vol. 14, No. 3, 57-60 (March, 1956).

A detailed account of the experimental determination of the buckling $B^2$ for a square lattice of 18 cm pitch of 1 in. dia. U slugs. Methods of analysis are considered and corrections made for reflector thickness and atmospheric pressure. The mean value for $B^2$ was 138.8. R.D.Smith

## ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18 : 530.145

INTRODUCTION TO SOME RECENT WORK IN MESON THEORY. See Abstr. 4208

539.18

5402. ON A POSSIBLE SCHEME FOR HEAVY UNSTABLE PARTICLES. C.Ceolin and N.Dallaporta.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 586-94 (March, 1956).

A level scheme is proposed for the heavy unstable particles and for their interactions with nuclei, in which an operator similar to a spin produces changes in "strangeness" analogous to the changes in charge produced by the isotopic spin. The proposed form of the interaction takes account of the experimental facts so far noted or admitted, the independent conservation of $\tau_3$ and strangeness in strong interactions according to the ideas of Gell-Mann, and charge independence for interactions between nucleons and pions. A.

539.18

5403. SOME HYPERFRAGMENT RESULTS. L.Leprince-Ringuet, J.Crussard, V.Fouché, J.Hennessy, G.Kayas, D.Morellet and F.Renard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1554-7 (March 19, 1956). In French.

Among 20 hyperfragments found in Berkeley- and cosmic-ray-exposed plates 15 non-mesonic disintegrations were observed. The remaining 5 mesonic decays yield estimates of $\Lambda^0$ binding energy. Unique interpretations are possible in three cases (two cases of $_\Lambda H^4$ and one $_\Lambda He^5$). A possible $_\Lambda Li^{7,8}$ gives a binding energy 6.1 ± 0.9 MeV. R.H.W.Johnston

539.18

5404. THREE EXAMPLES OF COMPLETE $\tau$-DECAY.
M.Scharff, G.Gjeldaker and S.O.Sørensen.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 216-18 (Jan., 1956).

Details of these events, found in a stack of stripped emulsions exposed during the 1953 Sardinia expedition, are tabulated and, assuming all secondaries to be $\pi$-mesons, the energies calculated using Baroni's et al. range-energy relation. The mean Q-value is (74.0 ± .5) MeV, corresponding to a $\tau$-meson mass of (964 ± 1) $m_e$. It is estimated that systematic errors of 3 $m_e$ can be introduced in the conversion of range to energy. E.W.Kellermann

539.18

5405. A NOTE ON THE ANALYSIS OF $\tau$-MESON EVENTS.
Y.Eisenberg, S.Rosendorff and Y.Yeivin.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 837-9 (April, 1956).

An analysis is made of the possible experimental biasses present in $\tau$-meson data to date. Six classes of event are possible, according to whether three, two (++ or +-), one (+ or -) or zero secondary particles come to rest. An unbiassed sample should be composed of all events of all classes. It is pointed out that omission of class-4 events (one stopping $\pi^+$) tends to transform [1 +] spectra into [0 −], and that relativistic calculations (in progress) may modify the theoretical spectra significantly. R.H.W.Johnston

539.18

5406. AN EXTRAORDINARY $V^0$ DECAY. E.Fridlender and S.Bercha.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 51-3 (1956). In Russian.

The particle found decays into a $\pi$-meson and a particle of mass m = (3620 ± 390) $m_e$, which is most likely a deuteron, but might be a hyperon. G.E.Brown

539.18

5407. ON THE PROPERTIES OF $\tau^+$-MESONS. N.N.Biswas, L.Ceccarelli-Fabbrichesi, M.Ceccarelli, K.Gottstein, N.C.Varshneya and P.Waloschek.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 825-31 (April, 1956).

An unbiased sample of 87 coplanar $\tau$ decays was obtained by "along the track" scanning in emulsion exposed to the Berkeley $K^+$ beam. A study of the pion angles and energies when compared with theoretical predictions indicates spin-parity [0−] or [1+]. A polarization test applied to the plane of decay yielded a negative result. It is suggested that the theory predicting the energy distributions may be oversimplified and that second-order effects may introduce appreciable modifications. R.H.W.Johnston

539.18

5408. FURTHER EVIDENCE ON THE NATURE OF THE NEUTRAL PARTICLES IN THE DECAY SCHEME OF $K_{\mu 3}$.
T.F.Hoang, M.F.Kaplon and G.Yekutieli.
Phys. Rev., Vol. 101, No. 6, 1834-5 (March 15, 1956).

In the course of a systematic scan for $K^+$-mesons at rest in emulsion exposed to the cosmotron $K^+$-beam, a decay was observed accompanied by an electron-pair. The secondary was identified as a $\mu$-meson of 110 ± 10 MeV kinetic energy by scattering and blob-density measurements. If the decay



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$K_{\mu 3} \rightarrow \mu + 2e + Y^0$ is assumed, then 170 MeV $\leq M_{Y^0} \leq$ 224 MeV. No known particle of this mass existing, the decay scheme $K_{\mu 3} \rightarrow \mu + \pi^0 + X^0, \rightarrow \mu + 2e + \gamma + X^0$ is indicated, where $M_{X^0} \leq$ 75 MeV. R.H.W.Johnston

539.18

5409. IMPOSSIBILITY OF EXPLAINING THE STABILITY OF HYPERONS BY LARGE SPINS. I.I.Gurevich.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 41-2 (1956). In Russian.

The existence of hypernuclei contradicts the possibility of the $\Lambda^0$ stability coming from a large spin; in such a nucleus the $\Lambda^0$ could simply give up a $\pi$-meson to another nucleon if there were no further selection rule forbidding this.
G.E.Brown

539.18

5410. MEAN LIFETIME OF NEGATIVE K-MESONS.
E.L.Iloff, G.Goldhaber, S.Goldhaber, J.E.Lannutti, F.C.Gilbert, C.E.Violet, R.S.White, D.M.Fournet, A.Pevsner, D.Ritson and M.Widgoff.
Phys. Rev., Vol. 102, No. 3, 927-8 (May 1, 1956).

$K^-$-mesons of 285-415 MeV/c momentum produced in a Cu target at 90° to the 6.2 BeV Bevatron proton beam were brought to rest in an emulsion block detector after a path length of 3 metres. "Along-the-track" scanning revealed 13 decays in flight for a total proper time 12.37 x $10^{-8}$ sec, giving a result $\tau_{K^-} = (0.95 \pm {}^{0.36}_{0.28}) \times 10^{-8}$ sec. No negative $\tau$-decay was observed. A diagram showing all $K^+$ and $K^-$ lifetime results (both emulsion and counter) to date is given. A unique result is not excluded. R.H.W.Johnston

539.18

5411. ANGULAR CORRELATIONS IN $V^0$ TYPE DECAYS.
M.Deutschmann, M.Cresti, W.D.B.Greening, L.Guerriero, A.Loria and G.Zago.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 566-73 (March, 1956).

Measurements have been made on 34 $V^0$-events produced by cosmic-ray particles in the lead plates of a cloud chamber, and the angular correlation between the production and decay planes has been studied. If one limits the analysis to the $V^0$-particles produced in interactions in which only a small number $N_h$ of heavily ionizing particles is seen to be emitted, a correlation is found in favour of small angles, whereas for large $N_h$ the correlation appears to vanish. A.

539.18

5412. POSSIBLE METHOD OF MEASURING MAGNETIC MOMENTS OF V-PARTICLES. M.Goldhaber.
Phys. Rev., Vol. 101, No. 6, 1828 (March 15, 1956).

It is suggested that the above may be measured in cloud chambers with fields of the order of 18 000 gauss. Time of flight $\sim 10^{-9}$ sec and gyromagnetic ratio $\sim 2$ would give a precession of the decay plane distribution of the order of 10°. The method might be applied to hypernuclei produced by $K^-$-mesons in well-defined reactions. The shorter distances involved here would require more intense (pulsed) magnetic fields. R.H.W.Johnston

539.18

5413. ON THE SPIN OF ARTIFICIALLY PRODUCED $\tau$-MESONS. B.Bhowmik, D.Evans, I.J.van Heerden and D.J.Prowse.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 574-85 (March, 1956).

Measurements have been carried out on the $\pi$-meson secondaries arising from the decay of positive $\tau$-mesons recorded in a stack of nuclear emulsions which had been exposed to the positive K-meson beam of the Berkeley bevatron. The distribution in energy of these secondaries is shown to be consistent with the view that the $\tau$-meson is a pseudo-scalar particle and they appear to exclude the possibility that the spin and parity of the particle are $1^-$, $1^+$, $2^+$ or $3^-$. A.

539.18

5414. THE EVIDENCE FROM ANGULAR CORRELATIONS ON THE SPIN OF THE $\Lambda^0$. G.Morpurgo.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1069-92 (May, 1956).

A method for establishing a lower limit to the spin of the $\Lambda^0$ is described; the method is based on the observation that the possible simultaneous shapes of the two angular distributions in cos $\theta$ and $\varphi$ ($\varphi$ = angle between the plane of production and the plane of decay; $\theta$ angle between the line of flight of the $\Lambda^0$ and the line of flight of the decay products in the rest system of the same) are, for any assumed spin connected with each other and severely restricted. A detailed analysis is presented, for the cases of spins 3/2 and 5/2. The insufficient statistics of the experimental data presently available (12 cases not of completely homogeneous nature) does not allow at the moment any definite conclusion to be expressed. However if some trends present in the data are confirmed a spin of 5/2 or higher is necessary. A.

539.18

5415. SCATTERING OF NEGATIVE $\pi$-MESONS IN HYDROGEN STUDIED BY MEANS OF A DIFFUSION CHAMBER.
M.Kozodaev, R.Sulyaev, A.Filippov and Yu.Shcherbakov.
Dokl. Akad. Nauk. SSSR, Vol. 107, No. 2, 236-9 (1956). In Russian.

About 12 000 photographs were taken of events in a 270 mm diffusion chamber filled with hydrogen at 20 atm and irradiated with 330 ± 6 MeV mesons. On the average, four particles per pulse went into the chamber. Eleven cases of elastic scattering were found, giving $\sigma_{el} = (11 \pm 4) \times 10^{-27} cm^2$. For charge-exchange scattering, $\sigma = (13 \pm 4) \times 10^{-27} cm^2$.
G.E.Brown

539.18

5416. ON GENERALISED DISPERSION RELATIONS. II.
A.Salam and W.Gilbert.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 607-11 (March, 1956).

Considerations of Pt I (Abstr. 4662/1956) are generalized to write down non-forward scattering, spin-flip dispersion relations. The contribution from the "bound state" is discussed. A.

539.18

5417. ON THE PION–NUCLEON INTERACTION. P.Budini
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1104-11 (May, 1956).

A non-local model for the pion–nucleon interaction is presented assuming that the pion interacts with the nucleon through an intermediate field. This internal field provides factors in the integral equations of the pion–nucleon scattering which play the role of the usual mathematical form factors of the non-local theories. With a proper choice of the mass of the internal quanta and of the coupling-constant and after renormalization of the integral equations on the Chew scheme the known behaviour of the P phases of pion–nucleon scattering at low energy can be reproduced. A.

539.18

5418. INTERPRETATION OF $K^+$ SCATTERING IN NUCLEAR EMULSIONS. L.S.Osborne.
Phys. Rev., Vol. 102, No. 1, 296-7 (April 1, 1956).

The experimental absence of $K^+$ absorption and small scattering cross-section permit a simple Born-approximation single-scattering model to be used. The experimental angular distribution and energy variation is in agreement with S-wave scattering. Assuming interaction in a T = 1 state gives a scattering/charge-exchange ratio of 5 to 1, not contradicted by experiment. On the above basis predictions are made of the expected number of scatterings for given path lengths in given intervals of the parameter $4 p\beta \sin^2(\frac{1}{2}\theta)$ for both attractive and repulsive nuclear force. Experimental work (unpublished) favours the former. R.H.W.Johnston

539.18

5419. ABSORPTION OF K⁻-PARTICLES BY NUCLEI. V.B.Cheston.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 645-6 (March, 1956).

The relative frequencies of mesonic and non-mesonic absorption of $K^-$-mesons by light nuclei have been computed for the cases $Y = \Sigma$ and $Y = \Lambda$. Non-mesonic absorption should occur in about 20% and 55% of the cases respectively. These figures must be modified, by taking into account nuclear absorption of the real pions produced, before being compared with experiment. R.H.W.Johnston

539.18

5420. HIGH-VELOCITY PARTICLE RANGES IN EMULSION. W.H.Barkas, P.H.Barrett, P.Cüer, H.H.Heckman, F.M.Smith and H.K.Ticho.
Phys. Rev., Vol. 102, No. 2, 583-4 (April 15, 1956).

The ranges in emulsion of positive $\pi$-mesons of equivalent proton energy of 200, 340, 550 and 700 MeV have been measured. The G.5 emulsion density was 3.822 g/cm³ and the emulsions were conditioned before exposure in a container with a definite quantity of water. Corrections were made for the deformations suffered by the emulsions in clamps during exposure. The values given for the equivalent proton ranges are $24.59 \pm 0.12$, $52.20 \pm 0.32$, $74.06 \pm 0.40$ cm for the above equivalent proton energies. The ranges were determined by measuring straight segments. The shrinkage factor was obtained from thickness measurements before and after processing. The momentum of the particles was known to a few parts in 10 000 by bending the particles in the known field of the cyclotron. D.J.Prowse

539.18

5421. TOTAL CROSS-SECTIONS OF POSITIVE PIONS IN HYDROGEN. A.E.Ignatenko, A.I.Mukhin, E.B.Ozerov and B.M.Pontekorvo.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 7-11 (1956). In Russian.

Total proton cross-sections of positive pions were determined by attenuation in liquid hydrogen. Conclusions on the contribution to the cross-section by states with different isotopic spin are drawn from the present measurements as well as from determinations by the authors of the hydrogen and deuterium cross-section of negative pions in the 140-400 MeV region. A.

539.18

5422. THE CAPTURE OF NEGATIVE HYPERONS. S.J.Goldsack and W.O.Lock.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 600-6 (March, 1956).

Three events are described which probably represent the capture of negative hyperons. In each case a single fast proton is emitted of energy between 60 and 70 MeV. The present experimental data on $Y^-$ capture are summarized and briefly discussed. A.

539.18

5423. INTERACTION OF 300 MeV $\pi^-$ MESONS WITH PROTONS, DEUTERONS AND PHOTO-EMULSION NUCLEI. L.S.Dul'kova, T.A.Romanova, I.B.Sokolova, L.V.Sukhov, K.D.Tolstov and M.G.Shafranova.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 43-6 (1956). In Russian.

Emulsions were filled with $CH_3COOLi.2H_2O$, lithium acetate, which allows a great deal of hydrogen (and in this acetate deuterium can easily be substituted for hydrogen) to be put in without swelling and general distortion. Further, the presence of lithium allows a control on the amount of material by spectral or chemical analysis. Also, the $\alpha$-$H_1^3$ stars produced in irradiating the emulsion with slow neutrons make it possible to control the uniformity of loading. The total cross-section of interaction with photoemulsion nuclei was $88 \pm 5\%$ of geometrical. The distribution of stars with number of rays is given. An angular distribution of elastic scattering of $\pi^-$ on hydrogen is plotted from 50 events; 11 cases were found for D. Cross-sections were $\sigma_H = (14 \pm 3.5)$ mb; $\sigma_D = (15 \pm 5.5)$ mb. G.E.Brown

539.18

5424. PRIMARY IONIZATION SPECTRUM OF FAST $\mu$ MESONS. G.P.Eliseev, V.A.Lyubimov and A.M.Frolov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 2, 233-5 (1956). In Russian.

Momenta in the range 0.2-34 GeV/c are determined by a magnetic field. The ionization shows the characteristic logarithmic rise from minimum ionization and then the saturation due to polarization of the medium. G.E.Brown

539.18

5425. STAR PRODUCED BY THE CAPTURE OF A HYPERON $\Sigma^-$. Tsai-Chü.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 921-9 (May, 1956).

A flat track of 876 $\mu$m emitted from a primary star of 19 prongs came to rest in the emulsion and produced a small star of three prongs. Direct mass determinations of this track give $2830 \pm 560$ $m_e$ by ionization and $2560 \pm 790$ $m_e$ by scattering. Two prongs of the secondary star can be identified as $\alpha$-particles; the star has a visible energy of 18 MeV. The small star has been explained by the reaction $\Sigma^- + p \rightarrow \Lambda^0 + n$; the capture of a negative hyperon by a proton inside a nucleus with a few low energy nucleons knocked out of the target nucleus. This event may be the break-up of a light nucleus by the neutron and $\Lambda^0$. A.

539.18

5426. WEAK INTERACTIONS OF HYPERONS AND HEAVY MESONS. B.d'Espagnat and J.Prentki.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1045-59 (May, 1956). In French.

In order to account for the selection rule $\Delta I = \pm \frac{1}{2}$, which seems to govern the decay of hyperons and heavy mesons, the relevant interaction Hamiltonian is taken as the component of a 1st kind spinor in isotopic space. Without further hypothesis concerning the types of interaction and the number of independent Hamiltonians this already provides relations which could be tested by experiment and could also provide information, especially on the spin and parity of the $\Sigma$. This is partly due to the fact that the scattering in the final state has some effect on the decay probabilities. A convenient means for writing down explicitly such Hamiltonians is also given. This leads to a discussion of the choice Fermi-type versus Yukawa-type. No convincing argument can be given at the present stage for either of the two types. On the assumption of a Yukawa-type, chosen because of its greater simplicity, the consequences of some natural choices of the coupling constants are investigated. A.

539.18

5427. INTERACTIONS OF POSITIVE K-MESONS. J.E.Lannutti, W.W.Chupp, G.Goldhaber, S.Goldhaber, E.Helmy, E.L.Hoff, A.Pevsner and D.M.Ritson.
Phys. Rev., Vol. 101, No. 5, 1617-18 (March 1, 1956).

These have been studied by means of the focused Berkeley Bevatron K-meson beam in the energy range 30-120 MeV. In accordance with conservation of "strangeness" for positive K-mesons only elastic, inelastic and charge exchange scattering has been found and there was no evidence for absorption reactions or production of $\pi$-mesons or hyperons. The differential scattering cross-section is isotropic from 40°-180° in the lab. system. From 40° down to 20° there is a steep increase. A mean free path of $95 \pm 16$ cm in emulsion or $\sigma = 6$ mb/nucleon was found. Here the isotropic distribution has been subtracted which, according to a histogram, contributes an approximately equal amount to the total cross-section. H.Motz

539.18

5428. INTERACTIONS OF $K^-$-MESONS IN NUCLEAR EMULSION. D.M.Fournet and M.Widgoff.
Phys. Rev., Vol. 102, No. 3, 929-30 (May 1, 1956).

$K^-$-mesons of 400 MeV/c momentum produced in a Cu target at 90° to the 6.2 BeV bevatron proton beam were brought to rest in an emulsion block detector. 8.68 metres of $K^-$-meson track were followed, yielding 137 capture stars at rest, 23 interactions other than scattering and 6 decays in flight. A mean free path for $K^-$ interaction in flight $36.2 \pm {}^{9.2}_{6.1}$ is obtained for the energy region 0-100 MeV. The figures for energies 0-50 and 50-100 MeV are 26.7 and 40.9 cm respectively. The prong distribution of the "at rest" and "in flight" stars are similar, indicating that the process $K^- + N \rightarrow Y + \pi$ predominates, for interactions in flight of this energy, over scattering and charge exchange. R.H.W.Johnston

539.18

5429. KINEMATICS OF THE REACTION $K + p \rightarrow \pi + \Sigma$ AND OF THE ELASTIC SCATTERING $K + p \rightarrow K + p$. E.Pedretti.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 956-67 (May, 1956).

To facilitate the identification of K-mesons interactions, particularly in G5 emulsion, the kinematics of the reaction $K + p \rightarrow \pi + \Sigma$ and of the scattering $K + p \rightarrow K + p$ have been calculated and plotted for various kinetic energies of the incident K-meson. A.

539.18

5430. K-MESONS IN EMULSIONS EXPOSED TO A 6.2 GeV PROTON BEAM. J.Crussard, V.Fouché, J.Hennessy, G.Kayas, L.Leprince-Ringuet, D.Morellet and F.Renard.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 731-48 (April, 1956).

A large emulsion stack was exposed in the 6.2 GeV proton beam of the Berkeley bevatron. 414 $K^+$ decaying at rest were observed. Their probable time of flight is $\sim 5 \times 10^{-10}$ sec. 57 flat secondaries at or near minimum ionization have been extensively measured. The proportions of $K_\mu$, $\chi$, $K_\beta$, $\kappa$,$\tau$ and $\tau'$ are found to be respectively around 54%, 26%, 8%, 4%, 7% and 1%. They are not significantly different from the proportions in stacks exposed to the $K^+$ focused beam of the bevatron or to cosmic radiation, which indicates similarity in lifetimes and in relative frequencies of production for the different types of K's. The average range of 8 stopping secondaries of $K_\mu$ and of 4 stopping secondaries of $\chi$ are respectively $202.0 \pm 1.9$ mm and $118.8 \pm 1.7$ mm. The masses of $K_\mu$ and $\chi$ deduced from these ranges are very close to the masses found by direct measurement in the K beam. Two $\kappa$ events with secondaries of 61.5 and 90.5 MeV have been observed. The whole evidence on $\kappa$-mesons in large emulsion stacks is examined: it is felt that the results are so far consistent with the $\kappa \rightarrow \pi^0 + \mu + \nu$ scheme. Five $K^-$-events have been found and are described. A.

539.18

5431. MESON PRODUCTION AT VERY HIGH ENERGIES. E.Lohrmann.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 822-4 (April, 1956).

A high energy jet (5 + 30 p) found in a stack of stripped emulsions has been examined. The energy of the primary is between 1100 and 12 000 BeV. The mean energy of the mesons produced is between 1.7 and .5 BeV in the centre of mass system. The angular distribution of the emitted particles in the forward cone is strongly anisotropic in the c.m. system even assuming the upper limit of primary energy. The results are all in agreement with the multiple meson production theory of Heisenberg. A second jet (3 + 55 n) produced by a neutral particle (not a $\pi^0$) emitted by the first jet has also been found. The mean total energy of the mesons in the c.m. system is 270 MeV. Best symmetry in the angular distribution of the particles is obtained from a primary energy of 150 BeV. At this energy the number of mesons expected on the Fermi theory is only 5, which is obviously low. D.J.Prowse

539.18

5432. A MODEL FOR $\Lambda^0$ - $\theta^0$ PRODUCTION. L.F.Landovitz and J.Leitner.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1093-103 (May, 1956).

A calculation of the perturbation theoretic angular distributions in the reaction $\pi^- + p \rightarrow \Lambda^0 + \theta^0$ is reported. Some general implications of the model $\pi^- + p \rightarrow$ single particle $\rightarrow \Lambda^0 + \theta^0$ are described. The second order results for the productions distributions are of the form $A + B \cos\theta$ for all choices of spin, coupling, etc. The exact centre of mass distribution is identical in form to that above but is determined only to within an unknown parameter $\xi$. The nature of the distributions preclude the possibility of verification of the model on the basis of present data. The decay angular distributions of the spin $\frac{1}{2}$ $\Lambda^0$ are isotropic for all values for the $\theta^0$ spin. Possibilities for future comparison with experiment are discussed. A.

539.18

5433. HYPERFRAGMENT PRODUCTION. H.Uberall.
Phys. Rev., Vol. 101, No. 5, 1612-13 (March 1, 1956).

Assuming a simple model (valid for $Z \geq 3$) the probability of formation of an excited fragment of charge Z is expressed in terms of (a) the average number n(Z) per star of (unexcited) fragments and (b) the cross-section $\sigma_\Lambda f$ for a $\Lambda_0$-particle to be produced and to remain in the nucleus. Using results of a Monte Carlo calculation by Jastrow (Abstr. 2215/1955) for $\sigma_\Lambda f$ and using the experimental results of Perkins (Abstr. 597/1951) for n(Z), a hyperfragment charge spectrum is obtained which agrees approximately with available emulsion data. R.H.W.Johnston

539.18

5434. POLARIZATION OF THE DEUTERON IN THE REACTION $p + p \rightarrow \pi^+ + d$. R.D.Tripp.
Phys. Rev., Vol. 102, No. 3, 862-6 (May 1, 1956).

Using 340 MeV unpolarized protons, the polarization of deuterons produced at a centre-of-mass angle of 115° in the $p + p \rightarrow \pi^+ + d$ reaction has been measured. The deuterons were detected in coincidence with the mesons and were analysed by scattering from a carbon target at 24°. In conjunction with previous experiments on the reaction, this measurement completes the specification of the phenomenological parameters of Rosenfeld and Gell-Mann and Watson. Specifically it permits the determination of the relative phases of the several modes of meson production, which in turn are related to the p-p phase-shifts at this energy. A.

539.181

5435. MOLECULAR BEAMS. N.F.Ramsey.
London: Oxford University Press (1956) 478 pp., 8 plates, 195 text-figures. (International Series of Monographs on Physics).

This monograph is the first detailed book published during the past twenty-four years on molecular beam research. Both the molecular beam experiments and the theoretical physics associated with them are discussed in detail.

539.185

5436. POLARIZATION EFFECTS IN NEUTRON-PROTON SCATTERING AT 98 MeV. P.Hillman and G.H.Stafford.
Nuovo Cimento (Ser. 10), Vol. 3, No. 3, 633-41 (March, 1956).

The polarization in free neutron-proton scattering has been measured at $98 \pm 3$ MeV as a function of scattering angle. A maximum asymmetry $\epsilon = 4\%$ corresponding to a polarization of 39% is indicated. The angular distribution departs strongly from anti-symmetry about 90° centre of mass angle. A.

539.185 : 538.114

THEORY OF NEUTRON SCATTERING BY A FERROMAGNET. See Abstr. 4488-9

## STRUCTURE OF SOLIDS 539.2

539.216.1 : 548.5

5437. ON THE COARSENING OF NON-SAG TUNGSTEN LAMP FILAMENT WIRES. S.Oghi.
. Phys. Soc. Japan, Vol. 11, No. 5, 593-8 (May, 1956).

In order to make clear the non-sag nature of tungsten amp filament, its recrystallization behaviour was studied by optical microscope and X-ray diffraction. Filament which is ot non-sag begins recrystallization in a preferred orientation related to initial fibre direction at temperature about .000° C. This orientation is destroyed at about 1300° C, leading to an ordinary non-preferential polygon structure. The subsequent grain growth is very slow even at considerably higher temperatures. With non-sag wires on the other hand, his oriented recrystallization is maintained up to 2000° ~ 2100° C, followed by abrupt coarsening, in which the coarsened crystals encroach directly on the remaining fibre structure. Thus, the coarsened crystals tend to occupy the whole cross-section of the wire, and the filament comes finally to form a chain of single crystals. This phenomenon was interpreted as the inhibition-dependent coarsening advocated by Beck and others in 1949. This inhibiting action in tungsten filament is most likely caused by minute quantities of doped materials. A.

539.217 : 537.311.33

DIFFUSION OF DONOR AND ACCEPTOR ELEMENTS IN SILICON. See Abstr. 4403

539.219

5438. TRANSFORMATION IN DISORDERED GOLD COPPER ALLOYS. G.C.Kuczynski, M.Doyama and M.E.Fine.
J. appl. Phys., Vol. 27, No. 6, 651-5 (June, 1956).

By measurement of the specific heat, temperature coefficient of expansion, Young's modulus and yield point in $Cu_3Au$ alloys, it has been established that this alloy undergoes a phase transition between 550° and 600° C and possibly another one near 850° C. The temperature of the 550-600° C transition decreases sharply as the composition of the alloy deviates from $Cu_3Au$. A.

539.219

5439. STRUCTURES AND PHASE RELATIONSHIPS IN THE TANTALUM—HYDROGEN SYSTEM BETWEEN −145 AND 70° C. T.R.Waite, W.E.Wallace and R.S.Craig.
J. chem. Phys., Vol. 24, No. 3, 634 (March, 1956).

Reports the precipitation from H in Ta solid solutions ($\alpha$) of a body-centred tetragonal phase ($\beta$) of approximate composition $Ta_2H$. From X-ray measurements, electrical resistance measurements and previous specific heat data, a phase diagram has been established; this shows that the $\alpha$ solid solution is stable above about 50° C at all H concentrations up to the highest studied (40 atomic %). A.B.Lidiard

539.219 : 537.226.2

5440. SOLID SOLUTIONS OF ICE AND $NH_4F$ AND THEIR DIELECTRIC PROPERTIES. S.Zaromb and R.Brill.
J. chem. Phys., Vol. 24, No. 4, 895-902 (April, 1956).

The solidus curve for the system $H_2O$—$NH_4F$ was partly determined by means of chemical analyses, heating curves and a dilatometric method, and partly estimated from the liquidus curve using a thermodynamic relation. The solubility limit thus estimated is roughly 10%. The dielectric relaxation times, $\tau$, of solid solutions of ice containing 0.002 to 10 weight % $NH_4F$ were measured at temperatures of about −60° to −10° C. The activation energies for dipole rotation were only about 4 kcal/mole as compared with 13 kcal/mole in pure ice. At low concentrations the frequency factor increases with increasing concentration of $NH_4F$. At high concentrations of $NH_4F$ this trend is reversed. A.

539.219 : 538.632

5441. HALL EFFECT IN SOLID SOLUTIONS.
W.F.Flanagan and B.L.Averbach.
Phys. Rev., Vol. 101, No. 5, 1441-2 (March 1, 1956).

The Hall effect has been measured in Au-Ni, Cu-Ni, Au-Ag, and Cu-Au solid solutions at 80° and 300° K as a function of composition. The apparent number of conduction electrons is not linear with composition in the Au-Ag and Au-Cu alloys, and it is proposed that this effect is caused by the presence of diffuse Brillouin zone boundaries which arise from the short-range order. A.

539.23

5442. THE TRANSFER OF MONOMOLECULAR FILMS TO SOLID SUPPORTS. L.Schacht, G.Scheibe and H.Schuller.
Z. Elektrochem., Vol. 59, No. 9, 865-7 (1955). In German.

The Blodgett—Langmuir technique of transferring monolayers of surface-active substances from a water surface to a solid slide was investigated systematically. Four solid surfaces were used viz. freshly cleaved mica, glass, glass coated with $MgF_2$ and copper. The contact angles between these solid surfaces and water were measured under several conditions. The films were of barium stearate and an organic polymer. J.Iball

539.231

5443. SIMPLE, RAPID SPUTTERING APPARATUS.
R.B.Belser and W.H.Hicklin.
Rev. sci. Instrum., Vol. 27, No. 5, 293-6 (May, 1956).

A simple sputtering apparatus that consistently deposits opaque films of nickel and the noble metals in 3 to 10 min has been made. The chamber is constructed from a standard Pyrex pipe reducer. By use of a large-diameter aluminium rod as the cathode support and a hemispherical aluminium shell as a shield for the pump orifice and base plate, the glow discharge has been confined primarily to the volume between the cathode and the work stand. The efficiency of the coating unit has thereby been increased. Films of nickel, iridium, ruthenium and osmium formed on glass or quartz substrates were very adherent and were not readily scratched with a steel scribe. A.

539.234 : 539.27

5444. INFLUENCE OF THE THICKNESS OF THIN LAYERS ON THEIR STRUCTURE: THE CASE OF THE ALLOY Cu—Be.
A.Viswanathan.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1586-7 (March 19, 1956). In French.

Thin films (appreciably less than 1000 A thick) of a mixture of Cu and Be containing 58 at. % Be, obtained by evaporation, appear to be relatively deficient in Be, according to electron diffraction measurements, only the $\gamma$-phase (Cu Be) being in evidence at a thickness of 150 A. On heating, the $\delta$-phase ($Cu\,Be_2$) appears and electron diffraction photographs show the correct composition. The phenomenon is explained by the assumption of the solid solution of Be in the $\gamma$-phase before heating. J.Thewlis

539.26/.27 : 536.48

5445. LOW TEMPERATURE SPECIMEN METHOD FOR ELECTRON DIFFRACTION AND ELECTRON MICROSCOPY.
G.Honjo, N.Kitamura, K.Shimaoka and K.Mihama.
J. Phys. Soc. Japan, Vol. 11, No. 5, 527-36 (May, 1956).

Convenient low temperature specimen holders were constructed with a sufficient number of freedoms to adjust specimen settings for various observations. The temperature of the specimen support could be varied within a range from liquid nitrogen temperature to +200° C. Contaminations of specimen caused by condensation of residual vapours, which usually occur considerably below −80° C, were practically eliminated by improving the vacuum of the apparatus and by the use of a special shield around the specimen. Results of preliminary studies on ice and mercury are briefly described:

For ice, the contribution of hydrogen atoms to the diffraction pattern of ice was recognized; for mercury, the solid–liquid phase transition was studied by electron diffraction and the growth of hair-like mercury crystallites was observed by electron microscopy. A.

539.27

5446. ULTRA-VIOLET POLYMERIZATION OF EMBEDDING MONOMERS FOR THIN SECTIONING. A.Charles and J Sikorski

Brit. J. appl. Phys., Vol. 7, No. 4, 152 (April, 1956).

For the preparation of thin sections for electron microscopy, reproducible polymerization of iso-butyl, n-butyl, ethyl or methyl esters of methacrylic acid by means of u.v. light, without a catalyst, can only be obtained if the inhibitor in the monomer is removed by distillation in an atmosphere of nitrogen. If the inhibitor is removed by alkali a catalyst is necessary and "benzoin" has been found satisfactory. It is preferable to purify the ordinary yellow crystals of benzoin. With 1% benzoin the polymerization takes 2 hours if held 10 in. from a 125 W high-pressure Hg lamp. A colourless, tougher polymer is obtained with 0.5% benzoin in the monomer held for 8 hours at 24-30 in. from the Hg lamp, which is surrounded with a Wood's glass filter. The catalyst polymerization is only recommended for embedding robust material such as textile fibres. J.Iball

539.27

5447. DIRECT CARBON REPLICAS FROM METAL SURFACES. E.Smith and J.Nutting.

Brit. J. appl. Phys., Vol. 7, No. 6, 214-17 (June, 1956).

Two methods have been developed for the removal of carbon replica films directly evaporated on to etched metal surfaces. These involve either electropolishing or chemically etching after deposition of the carbon. The film removed by electropolishing gives a replica of high resolution, whilst with the etching technique extraction replicas may be prepared from multiphase alloys and the extracted phases identified by electron diffraction. Some examples of the application of the techniques to carbon and alloy steels are given. A.

539.27

5448. APPLICATION OF THE METHOD OF IONIC SCOURING IN ELECTRON DIFFRACTION: STUDY OF THE STRUCTURE OF THERMAL DEPOSITS ON CRYSTALLINE OR AMORPHOUS SUPPORTS. J.J.Trillat, N.Terao, L.Tertian and H.Gervais.

J. Phys. Soc. Japan, Vol. 11, No. 4, 406-12 (April, 1956).

A method is used which allows a sample to be bombarded with ions with simultaneous examination of its structure. In these conditions a progressive scouring of the superficial coats is obtained; electron diffraction gives information about the structure so laid bare. It is thus possible to study continuously the relations of epitaxy between the support and the metal laid down in various conditions. The method is applied to gold deposits on various supports. Sources of error are pointed out. A.

539.27 : 539.374

5449. AN ELECTRON DIFFRACTION STUDY ON THE PLASTIC DEFORMATION OF ALUMINIUM SINGLE CRYSTALS. K.Kimoto.

J. Phys. Soc. Japan, Vol. 11, No. 5, 485-95 (May, 1956).

The deformation was studied by means of Kikuchi lines of electron diffraction using a new technique, the large-angle convergent beam method. By this method the irradiated area on the specimen surface can be reduced to 5 x 20 $\mu^2$, and thus laminar regions and deformation bands can be studied separately. For 99.99% aluminium it was found that in laminar regions the distortion is so small that Kikuchi lines are produced even at 10% elongation, and that in deformation bands it is large enough to extinguish Kikuchi lines. For 99.55% aluminium, at any place in the crystal the distortion is so large that Kikuchi lines become diffuse at about 3% elongation and are extinguish at about 7% elongation. It was confirmed in all cases that no rotation occurs in the slip plane. The interior of elongated crystals was studied after removal of the surface layer by electropolishing. Irrespective of the purity of crystals, no recognizable difference was found in the surface layer and in the interior. The order of dislocation density was estimated through Kikuchi line experiment. The results obtained for 99.99% aluminium are $10^6$ lines/cm$^2$, $10^7$ lines/cm$^2$, and $10^8$ lines/cm$^2$ for well annealed crystals, for laminar regions of 10% elongated crystals, and for deformation bands of 10% elongated crystals, respectively. A

539.27 : 539.374

5450. STUDY OF PLASTIC DEFORMATION IN ALUMINIUM CRYSTALS BY ELECTRON DIFFRACTION AND ELECTRON MICROSCOPY. F.E.Fujita, D.Watanabe, M.Yamamot and S.Ogawa.

J. Phys. Soc. Japan, Vol. 11, No. 5, 502-15 (May, 1956).

Single crystals of very pure aluminium (99.99%) were plastically deformed and examined by means of electron micr scopy and electron diffraction. Surfaces of the deformed crys tals produce innumerable slip lines of various slip amounts, and deformation bands. The latter greatly affect the diffraction pattern; Laue spots are split, Kikuchi lines are extinguished, and a very high background results. As a result, the diffraction pattern from the crystal part containing deform ation bands becomes obscured after only a few % elongation, while the effect of crystal imperfections associated with slip lines on the electron diffraction patterns appears to be small, Kikuchi patterns being obtained from laminar-slip regions in a crystal even after 20% elongation. The local distortions expected from the diffraction patterns cannot be explained in terms of rotations about the [111] axis or in the active slip planes, but rather consist in local bendings about the [211] axis due to deformation bands. Difference between the state of plastic deformation in the vicinity of the surface and that in the interior of the crystal is conjectured from the differenc between the corresponding diffraction patterns. A.

539.27

5451. ELECTRON MICROSCOPIC STUDY ON THE STRUCTURE OF MOSAIC BOUNDARIES IN Ni–Mn SINGLE CRYSTAL T.Taoka and S.Aoyagi.

J. Phys. Soc. Japan, Vol. 11, No. 5, 522-7 (May, 1956).

For the purpose of studying the structure of mosaic bound aries in an alloy, observation of etching pits on the (110) plane of a Ni–Mn single crystal has been made by an electron micr scope. The results obtained are summarized as follows: (i) Mosaic boundary is composed of a set of parallel edge dislocations which are regularly spaced on a crystal lattice plane model, as shown by Burgers. (ii) These edge dislocations are along ⟨112⟩ crystallographic direction with Burgers vector $a/2\langle 110\rangle$, or along ⟨100⟩ direction with Burgers vector $a\langle 100\rangle$ as suggested by Frank. (iii) The dislocations are regularly spaced on the {110} or {100} plane which is perpendicular to its Burgers vector. A.

## ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.31

5452. VARIATION OF THE YOUNG'S MODULUS OF THE ALLOY $Mg_3Cd$ WITH THE ORDER–DISORDER TRANSITION. K.Tanaka and H.Maniwa.

J. Phys. Soc. Japan, Vol. 11, No. 3, 328-9 (March, 1956).

The modulus is measured by the change of the resonant frequency of longitudinal vibrations. Using this as an index, the time ($\tau$) taken to attain the half-value of the equilibrium state may be derived for different temperatures. The quan-

tity log $\tau$ is closely linear with 1/T, yielding an activation energy for the ordering process of 19.5 kcal/mole.

A.J.Kennedy

539.32 : 531.76

5453. APPARATUS FOR THE MEASUREMENT OF TIME OF IMPACT. P.L.Kirby.
Brit. J. appl. Phys., Vol. 7, No. 6, 227-8 (June, 1956).

Apparatus is described whereby the time of impact of a freely falling sphere on a horizontal surface is measured electrically without direct connection to the sphere. The time of impact of an 8 mm steel sphere on a solid Pyrex glass slab is 18 $\mu$s at room temperature and is the same within ± 10% at 700° C. Over this range of temperatures the absorption of fractional impact energy increases considerably and rebound is zero at about 1000° C. A.

539.32

5454. DEPENDENCE OF YOUNG'S MODULUS AND INTERNAL FRICTION OF COPPER UPON NEUTRON BOMBARDMENT. D.O.Thompson and D.K.Holmes.
J. appl. Phys., Vol. 27, No. 2, 191-2 (Feb., 1956).

For previous work see Abstr. 729 (1956). The functional dependence of these properties on neutron bombardment has now been obtained. It is found that

$$1/E_M = 1/E_E + C/(1 + \gamma nvt)^2$$

where $E_E$ is the purely elastic part of the modulus, C and $\gamma$ are constants independent of the integrated neutron flux nvt, and t is the time. Also

$$(\delta - \delta_1)/\delta_1 = C^1/(1 + \gamma nvt)^4$$

where $C^1$ is a constant, $\delta_1$ is the final value of the internal friction as the bombardment becomes infinite and $\gamma$ and nvt are the same as in the first equation. W.Bardsley

539.32 : 534.372

5455. THEORY OF MECHANICAL DAMPING DUE TO DISLOCATIONS. A.Granato and K.Lücke.
J. appl. Phys., Vol. 27, No. 6, 583-93 (June, 1956).

A quantitative theory of damping and modulus changes due to dislocations is developed. It is found that the model used by Koehler of a pinned dislocation loop oscillating under the influence of an applied stress leads to two kinds of loss, one frequency dependent and the other not. The frequency dependent loss is found to have a maximum in the high megacycle range. The second type of loss is a hysteresis loss which proves to be independent of frequency over a wide frequency range which includes the kilocycle range. This loss has a strain-amplitude dependence of the type observed in the kilocycle range. The theory provides a quantitative interpretation of this loss. A.

539.32 : 541.13

5456. THE LATTICE SPACINGS OF THIN ELECTRODEPOSITS OF COBALT AND NICKEL ON A COPPER SINGLE CRYSTAL. R.C.Newman.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 432-40 (April, 1956).

An electron diffraction investigation has been made of the lattice spacings of cobalt and nickel electrodeposited on to a copper single crystal. By the use of radioactive cobalt to measure the thickness of electrodeposits, it is shown that no continuous metal deposition occurs at cathode current densities less than 90 $\mu$A cm$^{-2}$. At current densities greater than this value, oriented cobalt is deposited. The results for nickel are similar and the critical current density is 100 $\mu$A cm$^{-2}$. The results show that where cobalt and nickel are deposited they have their normal lattice spacings. Previous claims that these metals form pseudomorphic layers have been reinterpreted without this assumption. A.

539.32 : 537.228.1 : 537.226.2

ELASTIC CONSTANTS OF POLARIZED BARIUM TITANATE CERAMICS. See Abstr. 4379

539.373

5457. DEFORMATION OF THIN COPPER CRYSTALS. H.Suzuki, S.Ikeda and S.Takeuchi.
J. Phys. Soc. Japan, Vol. 11, No. 4, 382-93 (April, 1956).

Stress/strain curves of many copper crystals having various radii from 0.06 to 1 mm were measured. The range of easy glide increases considerably when the radius of crystal decreases. In the case of suitably oriented crystals the range of easy glide reaches 50% in shear, when the radius of crystal decreases less than 0.1 mm. The extrapolation of the range of easy glide to the infinitesimal radius gives a value between 40 and 80% in shear irrespective of the initial crystal orientation. The hardening rate in the easy glide region considerably decreases with the decreasing crystal radius. Meanwhile, the critical shear stress, the stress required for the transition from the easy glide to the rapid hardening region, and the hardening rate in the rapid hardening region reveal only slight dependence on the crystal radii, i.e. the former two slightly increase and the last slightly decreases with decreasing crystal radii. These results are discussed qualitatively by introducing a concept "mean free path of dislocations" in a crystal. A.

539.374

5458. ON THE DEPENDENCE OF THE INITIAL DEFORMATION OF FACE CENTRED CUBIC METALS ON THE APPLIED STRESS. G.Müller.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 141-5 (1956). In German.

Extension—time curves were obtained for helical coils of silver and gold wire and, in the plastic region, were found to conform to the law: $\gamma = \gamma_0 + CT^\alpha + \Delta\gamma_{sp}$ where $\gamma$ = the angle of sheer, $\gamma_0$ the elastic part, T the time, $\Delta\gamma_{sp}$ a spontaneous torsion and C and $\alpha$ are constants. The best values of C and $\alpha$ were found in each case and then the line was extrapolated to determine the purely elastic strain at zero time ($\gamma_0$). The difference between this and the measured strain was the spontaneous initial strain ($\Delta\gamma_{sp}$). The spontaneous strain increased markedly with the applied shear stress and a comparison of the results with data published for aluminium and copper showed that a general relationship exists for face centred cubic metals. A.C.Whiffin

539.374

5459. THE VISCO-ELASTIC PROPERTIES OF NETWORK STRUCTURE. I. GENERAL FORMALISM. M.Yamamoto.
J. Phys. Soc. Japan, Vol. 11, No. 4, 413-21 (April, 1956).

Many kinds of amorphous high-polymer substances show non-ideal rheological behaviour even in 'static' observations. In this paper, the general stress—strain—time relation and energy of dissipation of these systems are treated by adopting the modified rubber-like network model in which the junctions connecting the polymer chains break up and reform continually. The probability of the breakage of the junction (i.e. the breakage of the chain) per unit time is not a constant, but a function of both the number of segments which construct the chain and the end-to-end distance of the chain. It is assumed that the velocities of deformation of the system and of the change of the situation of network structure are very much slower than those of the micro-Brownian movements of polymer segments. Therefore the statistical mechanical considerations of equilibrium states may be used to derive the stress—strain—time (S—S—T) relation at each 'instance' of macroscopic observations. From the general expression of S—S—T relation it is pointed out that, in the case of small deformation, the S—S—T relation is essentially similar to that of the phenomenological generalized Maxwell model, and the reciprocal of the probability of chain-breakage corresponds to the relaxation time of each Maxwell element. A.

539.4.016

5460. HARDENING OF IRON—NICKEL ALLOYS NEAR $Ni_3Fe$ COMPOSITION BY COLD WORK AND SUPERSTRUCTURE. E.Josso and X.Waché.

C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 1984-8 (April 16, 1956). In French.

Disorder-order transformation results in a much greater increase in hardness when the initial state of disorder is produced by heavy cold rolling rather then by quenching from 1000°C. Graphs are given showing hardness changes v. composition (60-85 at.% Ni) and time of heat treatment below the critical temperature. Max. hardness is observed close to $Ni_3Fe$ composition. J.Adam

539.42 : 541.183

5461. THE LOWERING OF FRACTURE-STRESS DUE TO SURFACE ADSORPTION. N.J.Petch.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 331-8 (April, 1956).

Gibbs' adsorption equation and the Griffith and dislocation theories of fracture are used to calculate this lowering. The possibility that such adsorption causes the embrittlement of iron by hydrogen is discussed and is shown to be in good agreement with measured fracture stresses. A.

539.43

5462. THE EFFECT OF FREQUENCY ON THE FATIGUE OF METALS. A.K.Head.
J. Phys. Soc. Japan, Vol. 11, No. 4, 468-70 (April, 1956).

Fatigue tests on 24 S-T aluminium alloy and pure annealed copper have not shown the frequency dependence predicted by Yokobori (Abstr. 6557/1955). W.Bardsley

539.434

5463. RELATION BETWEEN THE INITIAL INSTANTANEOUS EXTENSION IN CREEP AND THE YIELD STRESS AND COEFFICIENT OF WORK-HARDENING IN POLYCRYSTALLINE METALS. P.Feltham.
Nature (London), Vol. 177, 632 (March 31, 1956).

While studying the creep of high-purity polycrystalline lead under constant stress in the range 20-105°C, measurements were made of the initial instantaneous extension at the lower end of the temperature scale. The accuracy of measurement suffered at higher temperatures. The tensile stress ($\sigma$) was found to be related to the initial tensile strain (e) by the work-hardening law characteristic of polycrystalline metals of cubic symmetry ($\sigma^2/e = \chi(T)$ where $\chi(T)$ is the temperature-dependent coefficient of work-hardening. Since very slow creep occurs in polycrystalline lead at a tensile stress of about 30 kg/cm$^2$, its yield stress in shear is probably less than 15 kg/cm$^2$ and greater than the value of 3 kg/cm$^2$ given by single crystals of high purity. The yield value in shear is taken as 10 kg/cm$^2$, the shear modulus as $5 \times 10^4$ kg/cm$^2$, and the value of $\chi$ given by Mott's theory is $2.8 \times 10^5$ kg/cm$^2$ for a mean grain diameter of 0.11 mm and $1.7 \times 10^5$ kg/cm$^2$ for a diameter of 0.04-0.06 mm. These values agree well with the slopes of the lines obtained experimentally. A.C.Whiffin

539.501

5464. FINITE DISPLACEMENTS IN RHEOLOGICAL BODIES. A.E.Scheidegger.
Canad. J. Phys., Vol. 34, No. 5, 498-509 (May, 1956).

Customary rheological theories suffer from various drawbacks; they are either (i) restricted to too specialized "ideal" materials, or (ii) restricted to too special displacements, or (iii) restricted to too specialized mathematical representations. The present paper attempts to fill the need for a summary of the representations of the dynamics of arbitrary materials. The displacement within the continuous medium is described by three "co-ordinate" functions as functions of three "parameters" and of time. Extensive use is made of the fact that, insofar as the expression of any physical statement is concerned, "co-ordinates" and "parameters" are entirely equivalent. Formulae are deduced which enable one to express the boundary conditions, the equations of motion, and any chosen rheological condition in either parameter space or co-ordinate space. The notion of finite strain is scrutinized. A.

539.53

5465. THE PHYSICAL MEANING OF INDENTATION AND SCRATCH HARDNESS. D.Tabor.
Brit. J. appl. Phys., Vol. 7, No. 5, 159-66 (May, 1956).

A study of the plastic deformation of metals by hard indenters shows that the indentation hardness is essentially a measure of the plastic yield stress of the metal. With pyramidal (and conical) indenters the hardness, because of geometric similarity, is independent of the size of the indentation. With spherical indenters this is not so, the hardness increasing with size of indentation. From the increase in hardness with load, a semi-quantitative estimate may be made of the work-hardening characteristics of the metal. In the scratching and indentation of brittle solids such as minerals it is shown that the high hydrostatic pressures developed around the deformed region are often sufficient to inhibit brittle fracture. Under these conditions the deformation is primarily plastic. For this reason there is fairly good correlation between indentation and scratch hardness since both are essentially a measure of the plastic and not the brittle properties of the solid. From this approach it is possible to provide a physical basis for Mohs' scratch-hardness scale and to show that, excluding diamond, there is a reasonable 'equality of intervals' between each number on the scale. A.

539.62

5466. VAPOUR LUBRICATION OF TITANIUM AND ZIRCONIUM. G.W.Rowe.
Brit. J. appl. Phys., Vol. 7, No. 4, 152-3 (April, 1956).

Conventional boundary lubricants are ineffective for titanium on account of chemically inert oxide film. By exposing denuded Ti surface to iodine vapour in vacuo, a coating of titanium di-iodide with lamellar structure is formed. Friction falls from $\mu = 1.5$ to $\mu = 0.3$ and remains low on heating to 400°C. Similar reduction in friction observed when zirconium exposed to iodine or chlorine vapour. Experiments in air showed that low friction ($\mu = 0.15$) may be obtained by sprinkling iodine crystals on Ti surface. Cadmium iodide, with structure similar to titanium di-iodide, also reduces friction ($\mu = 0.11$). Further reduction to $\mu = 0.04$ obtained by vigourously rubbing lubricant into the surface. J.W.Menter

539.893

5467. THE PHYSICS OF VERY HIGH PRESSURES. E.Kuss
Chem.-Ingen.-Tech., Vol. 28, No. 3, 141-52 (March, 1956). In German.

A survey of problems relating to the generation and measurement of very high pressures is followed by the review of scientific results and industrial applications, including (1) possibility of a more accurate evaluation of equilibrium states and inter-molecular forces, (2) contribution to the study of the structure of liquids, (3) deformation of molecules and atoms under extreme pressures, and (4) determination of polymorphic transformations (e.g., the diamond synthesis, which is discussed in detail). F.Lachman

# PHYSICAL CHEMISTRY 541

## PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.123 : 532.14 : 533.12

5468. AN EXACT METHOD FOR THE CALCULATION OF COEXISTENT DENSITIES FROM VAN DER WAALS' TYPE EQUATIONS: A CORRECTION. S.W.Benson and C.S.Copeland.
J. chem. Phys., Vol. 24, No. 4, 905 (April, 1956).

In an earlier paper (Abstr. 6787/1955) it was stated that the difference of the coexistent densities fails to follow the usual parabolic law near the critical point. This is incorrect. E.H.Sondheimer

541.124

5469. REACTION OF PARAFFIN HYDROCARBONS WITH OZONIZED OXYGEN: POSSIBLE ROLE OF OZONE IN NORMAL COMBUSTION. C.C.Schubert and R.N.Pease.
J. chem. Phys., Vol. 24, No. 4, 919-20 (April, 1956).

Ozone in oxygen (about 3 mole %) reacts with isobutane at 38° C to give t-butanol and small amounts of acetone. At 150° C the product is liquid and contains increasing amounts of t-butyl hydroxymethyl peroxide. Reaction schemes are considered and the suggestion of bringing ozone into the general hydrocarbon–oxygen reaction at higher temperature is discussed. W.Good

541.124

5470. ON THE THEORY OF OXIDATION–REDUCTION REACTIONS INVOLVING ELECTRON TRANSFER. I. R.A.Marcus.
J. chem. Phys., Vol. 24, No. 5, 966-78 (May, 1956).

A mechanism for electron transfer reactions is described, in which there is very little spatial overlap of the electronic orbitals of the two reacting molecules in the activated complex. Assuming such a mechanism, a quantitative theory of the rates of oxidation–reduction reactions involving electron transfer in solution is presented. The assumption of "slight-overlap" is shown to lead to a reaction path which involves an intermediate state X* in which the electrical polarization of the solvent does not have the usual value appropriate for the given ionic charges (i.e., it does not have an equilibrium value). Using an equation developed elsewhere for the electrostatic free energy of nonequilibrium states, the free energy of all possible intermediate states is calculated. The characteristics of the most probable state are then determined with the aid of the calculus of variations by minimizing its free energy subject to certain restraints. A simple expression for the electrostatic contribution to the free energy of formation of the intermediate state from the reactants, $\Delta F^*$, is thereby obtained in terms of known quantities, such as ionic radii, charges, and the standard free energy of reaction. This intermediate state X* can either disappear to reform the reactants, or by an electronic jump mechanism to form a state X in which the ions are characteristic of the products. When the latter process is more probable than the former, the over-all reaction rate is shown to be simply the rate of formation of the intermediate state, namely the collision number in solution multiplied by $\exp(-\Delta F^*/kT)$. Evidence in favour of this is cited. In a detailed quantitative comparison, given elsewhere, with the kinetic data, no arbitrary parameters are needed to obtain reasonable agreement of calculated and experimental results. A.

541.127.1

5471. REACTIONS OF GASEOUS MOLECULE IONS WITH GASEOUS MOLECULES. II. D.O.Schissler and D.P.Stevenson.
J. chem. Phys., Vol. 24, No. 4, 926 (April, 1956).

See Abstr. 9209 (1955). When more complex molecular systems such as the lighter hydrocarbons are involved numerous reactions occur, having small but real negative temperature coefficients and cross-sections that appear to go to zero for finite values of the average speed of the ion. W.Good

541.128 : 537.311.33

5472. HETEROGENEOUS CATALYSIS BY SEMICONDUCTORS. A.Deschanvres.
Bull. Soc. Chim. France, 1956, No. 4, 732-9 (April). In French.

Theoretical. The mechanism of catalytic reactions is discussed with particular reference to the theory of chemisorption (including consideration of Schottky and Mott barriers), the kinetics of adsorption and the adsorption isotherm. Reactions treated in some detail are the decomposition of nitrous oxide, the oxidation of carbon monoxide, and the exchange $D_2 \rightleftharpoons H_2$. S.J.Gregg

## ELECTROCHEMISTRY 541.13

541.135

5473. OBSERVATIONS ON ION SEPARATION IN DILUTE SOLUTIONS BY FREEZING. J.P.Lodge, M.L.Baker and J.M.Pierrard.
J. chem. Phys., Vol. 24, No. 4, 716-19 (April, 1956).

The electrification produced by the freezing of dilute aqueous solutions was studied in an attempt to determine (1) the factors governing which ion is rejected by the ice phase, and (2) the interrelationship of concentration, freezing rate, observed potential, and ionic segregation between the phases for sodium chloride, which appears to be typical. It was shown that ionic rejection is not on the basis of ion size alone, though this is doubtless important. Ion segregation increases with freezing rate over the range studied. Observed interphase potential goes through a maximum as concentration is increased; at a given concentration, the potential also goes through a maximum as freezing rate increases. The freezing rate corresponding to this maximum potential is lowest in the vicinity of the concentration yielding the highest potential. The effects of concentration and freezing rate on the potential-time curves were also noted. Chemical analyses of the phases was complicated by self-electrolysis of the solution. Physical interpretations of some of these phenomena are offered. A.

## PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

5474. THE ENERGY EFFICIENCY OF THE PHOTOCHEMICAL PRODUCTION OF OZONE; THEORETICAL AND EXPERIMENTAL VALUES. E.Briner and A.Münzhuber.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1829-32 (April 9, 1956). In French.

It has been observed that ozone may be produced photochemically from oxygen by several different wavelengths in the range up to about 2000 A. The photochemical initiation by the shorter wavelengths has already been explained in terms of the dissociation of the $0_2$ molecule to give a normal and an excited atom. It is here postulated that the ozone production by radiation of wavelength 2000 A may proceed by the interaction of radiation quanta with oxygen double molecules, giving oxygen atoms and single molecules. These double molecules are known to exist in liquid oxygen in about 50% concentration. Experimentally determined values are given of energy efficiencies for lamps

of different power, for both gaseous and liquid oxygen. These are compared with the efficiencies of ozone production by electrolysis of sulphuric acid and by electrical discharges through oxygen gas. C.E.King

541.14

5475. PHOTOLYSIS OF ACETONE IN THE ABSENCE OF MERCURY. K.O.Kutschke and D.E.McElcheran.
J. chem. Phys., Vol. 24, No. 3, 618-19 (March, 1956).

It has been suggested (Abstr. 1332/1955) that the presence of mercury is of importance in all the reactions of the methyl radical, the formation of mercury dimethyl being an essential step. Experimental data are presented here which suggest that the presence of mercury has little or no effect in these reactions. C.E.King

541.14

5476. STABILITY OF ETHYLIDENE RADICALS. G.B.Kistiakowsky and B.H.Mahan.
J. chem. Phys., Vol. 24, No. 4, 922 (April, 1956).

A mechanism involving the ethylidene radical is suggested by the variation in the initial rate of production of CO, $C_2H_4$ and $C_4H_8$ with initial pressure of methyl ketene during photolysis of the latter using a high-intensity, low-pressure mercury arc. W.Good

541.14

5477. RATE OF RECOMBINATION OF RADICALS. I. A GENERAL SECTOR THEORY; A CORRECTION TO THE METHYL RADICAL RECOMBINATION RATE. A.Shepp.
J. chem. Phys., Vol. 24, No. 5, 939-43 (May, 1956).

A rotating sector theory is derived which is applicable to simple photochemical decompositions involving both 1st- and 2nd-order removal of radicals. This theory gives the behaviour of radicals under intermittent illumination as a function of two parameters: $\alpha$, the ratio of first- to second-order removal rates, and $\beta$, a function of flash time. This theory is used to recalculate the experimental data on the methyl radical recombination rate. The constant $k_2$ is found to be $2.2 \times 10^{13}$ cm$^3$ moles$^{-1}$ sec$^{-1}$ in the temperature range 125° C to 175° C. A.

541.14

5478. RATE OF RECOMBINATION OF RADICALS. II. THE RATE OF RECOMBINATION OF TRIFLUOROMETHYL RADICALS. P.B.Ayscough.
J. chem. Phys., Vol. 24, No. 5, 944-6 (May, 1956).

The rotating sector technique has been used to determine the rate of recombination of trifluoromethyl radicals produced by the vapour phase photolysis of hexafluoroacetone. Using the method of calculation described in Pt I the rate constant was found to be $2.3 \times 10^{13}$ cm$^3$ mole$^{-1}$ sec$^{-1}$ at 127° C. A.

541.146.5 : 774

PHOTOGRAPHIC ACTION OF $H_2O_2$ EMITTED BY ABRADED Si AND Ge. See Abstr. 4765

541.15

5479. MECHANISM OF THE RADIOLYSIS OF AQUEOUS GLYCINE SOLUTIONS. W.M.Garrison and B.M.Weeks.
J. chem. Phys., Vol. 24, No. 3, 616-17 (March, 1956).

A reaction sequence for the radiolysis of oxygen-free glycine solutions by cyclotron-produced He ions is proposed. Evidence for the occurrence of the intermediates $CH_2$.COOH and $NH_2$.CH.COOH is given. Radiation yield values are discussed. W.Good

541.15

5480. FIXATION OF NITROGEN BY IONIZING RADIATION AS NITROGEN DIOXIDE AND NITROUS OXIDE. P.Harteck and S.Dondes.
J. chem. Phys., Vol. 24, No. 3, 619 (March, 1956).

The reaction of oxygen and nitrogen in a nuclear reactor has been investigated over a considerable range of pressure, temperature, radiation intensity and mixture composition. A reaction scheme is given indicating the mechanism whereby nitrogen dioxide and nitrous oxide are produced. The optimu conditions are given for nitrogen fixation by this method. C.E.Kin

541.1

5481. MECHANISM OF THE RADIOLYSIS OF AQUEOUS FORMIC ACID SOLUTIONS. W.M.Garrison, W.Bennett and M.Jayko.
J.chem. Phys., Vol. 24, No. 3, 631-2 (March, 1956).

This is interpreted, for $\gamma$-ray and cyclotron (He ion) dat on the basis of the assumption that H adds reversibly to form acid according to $H + HCOOH \rightleftharpoons HC(OH)_2$. W.Goo

541.1

5482. IODIDE-METAPHOSPHATE GLASS. A.Hilsenrod and B.Gehauf.
J. chem. Phys., Vol. 24, No. 4, 914-15 (April, 1956).

Inorganic iodides, particularly zinc iodide, dissolved in metaphosphate glasses form systems which can be coloured by small doses (75 r) of high-energy radiation. Saturation of colour occurs at about 600 r. The coloration is stable at roo temperature after a slight fading but disappears on heating, the latter often precipitating the iodide. G.F.J.Garlic

541.1

5483. IRRADIATION OF CHLORAL HYDRATE SOLUTIONS A.Hilsenrod.
J. chem. Phys., Vol. 24, No. 4, 917-18 (April, 1956).

Irradiation-induced changes in the conductivity of chloral hydrate have been investigated as a means of measuring X-ra dosage. Sensitivity of these solutions to radiation increased with concentration. Addition of 0.01 M glucose to a 0.5 M solution of chloral hydrate almost doubled the sensitivity, but had little effect on a 2.5 M solution. Large amounts of glucos acted as inhibitors. C.B. Allsop

541.15

5484. RADIOLYSIS OF DILUTE SOLUTIONS OF DIPHENY PICRYL HYDRAZINE (DPPH) IN ORGANIC SOLVENTS. II. THE SPATIAL DISTRIBUTION OF THE PRIMARY FREE RADICALS. A.Chapiro.
J. Chim. phys., Vol. 51, No. 4, 165-77 (April, 1954).

For Pt I, see Abstr. 1817 (1954).

541.1

5485. RADIOLYSIS OF DILUTE SOLUTIONS OF DIPHENY PICRYL HYDRAZINE (DPPH) IN ORGANIC SOLVENTS. III. THE EFFECT OF OXYGEN–SOLVENT MIXTURES. L.Boub and A.Chapiro.
J. Chim. phys., Vol. 52, No. 9, 645-56 (Sept., 1955). In French.

The destruction of DPPH in benzene, chloroform and methyl acetate is a radical reaction and a linear function of dose for low-intensity radiation. The radical yield drops with increasing intensity. The radical yield in chloroform was greater in the presence of oxygen than in vacuo. In the case of chloroform and of methyl acetate, contrary to that of benzene, the after-effect is more pronounced when irradiatio is carried out in the absence of air. DPPH was added to mix tures of two solvents and used to measure the radical yields. It was shown that chloroform is protected by small amounts of benzene, whereas methyl acetate and chloroform sensitize each other and methyl acetate sensitizes benzene. M.Eber

541.15

5486. REMARKS ON THE RECENT DEVELOPMENT OF THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. M.Haissinsky.
J. Chim. phys., Vol. 52, No. 7-8, 513-18 (July-Aug., 1955). In French.

A speculative review of recent trends in the interpretation f the primary events after the passage of an ionizing particle hrough water. It is suggested that oxygen dissolved in water as a different chemical reactivity from oxygen in the gas hase. M.Ebert

541.15

487. THE PROBLEM OF CORRELATING RADIOCHEMICAL YIELD WITH THE PHYSICAL ASPECTS OF RADIATION QUALITY. L.H.Gray.
J. Chim. phys., Vol.52, No. 7-8, 519-27 (July-Aug., 1955). In French.

The radiation chemical yields vary with the L.E.T. linear energy transfer) of the ionizing radiation. This change s most rapid in the range of 6.5-25 keV/$\mu$ L.E.T. A curve or the efficiency of different ionizing radiations has been calculated on the assumption that only those parts of the track of the ionizing particle are effective where the L.E.T. is greater than 25 keV/$\mu$. This curve is in good agreement with experimental data on the yield of molecular hydrogen.

M.Ebert

541.15

5488. DIFFUSION SCHEME FOR RADICALS IN THE TRACKS OF IONIZING PARTICLES IN LIQUIDS. J.L.Magee.
J. Chim. phys., Vol. 52, No. 7-8, 528-38 (July-Aug., 1955). In French.

High local concentrations of intermediary reactive products are formed by ionizing particles and secondary electrons in a liquid medium. These reactive species are assumed to be free radicals, and their rate of dissipation due to diffusion or reaction is discussed for electron and proton tracks. The kinetics of two competing processes are considered, namely recombination reactions and reactions of radicals with radical acceptors. M.Ebert

541.15

5489. CHEMICAL EFFECTS DUE TO EXCITATION BY SECONDARY ELECTRONS FROM IONIZING RADIATIONS. J.Weiss.
J. Chim. phys., Vol. 52, No. 7-8, 539-44 (July-Aug., 1955). In French.

The energy deposited by secondary electrons is utilized for ionizations and excitations. Finally the secondary electrons are left with a kinetic energy too low to lead to excitation of some molecular species present in the solution. This fact may be important in systems containing solutes of widely different excitation potentials. One would expect, for instance, the species with the lowest excitation threshold to show an increasing sensitivity to radiation with increasing concentration.

M.Ebert

541.15

5490. THE PRIMARY CHEMICAL ACT IN THE RADIOLYSIS OF WATER. M.Cottin and M.Lefort.
J. Chim. phys., Vol. 52, No. 7-8, 545-55 (July-Aug., 1955). In French.

The "molecular yields" of $H_2$ and $H_2O_2$ reported in the literature are critically examined along the lines of current theories. The conclusion is drawn that the yield of $H_2$, in contrast to that of $H_2O_2$, is more independent of dissolved matter. For $\alpha$-radiation the yield of $H_2O_2$ is variable and always smaller than that of $H_2$. $G_{H_2}$ was found to be 1.6 for Po $\alpha$-rays. M.Ebert

541.15

5491. RADICAL AND MOLECULAR YIELDS IN AQUEOUS SOLUTIONS OF ACRYLAMIDE IRRADIATED WITH 50 AND 220 kVp X-RAYS. E.Collinson, F.S.Dainton and G.S.MacNaughton.
J. Chim. phys., Vol. 52, No. 7-8, 556-69 (July-Aug., 1955). In French.

In neutral de-aerated water acrylamide is polymerized by X-rays via the action of H and OH free radicals. Monomer transfer does not occur. $H_2O_2$ is formed and does not interfere with the rate or degree of polymerization. With increasing monomer concentration $G_{H_2O_2}$ rises from a value of 0.2 to a maximum of 0.8 $\pm$ 0.5 for monomer concentration of $10^{-3}$ - $10^{-2}$ M and falls to about 0.25 for 0.5 M monomer concentration. At these high monomer concentrations the precursors of the molecular $H_2O_2$ are captured for the polymerization reaction. In acid solution ferric ions oxidize polyacrylamide radicals and terminate the growing chains. M.Ebert

541.15

5492. FORMATION OF HYDROGEN PEROXIDE IN SOLUTIONS OF $O^{16}O^{18}$ IN $H_2O^{16}$ BY GAMMA RADIATION. E.J.Hart, S.Gordon and D.A.Hutchison.
J. Chim. phys., Vol. 52, No. 7-8, 570-7 (July-Aug., 1955). In French.

The primary products are isotopically normal hydrogen peroxide and oxygen and hydrogen peroxide enriched in $O^{18}$. The yield of normal hydrogen peroxide is independent of pH between 0.4 and 9.65, whereas the yield in enriched hydrogen peroxide decreases with increasing pH. A kinetic scheme is suggested which distinguishes between molecular and radical intermediates and is in good agreement with detailed observations. M.Ebert

541.15

5493. QUANTITATIVE STUDY OF RADIATION-CHEMICAL REACTIONS. III. OXIDATION OF FERROUS SULPHATE BY BETA-PARTICLES. D.M.Donaldson and N.Miller.
J. Chim. phys., Vol. 52, No. 7-8, 578-86 (July-Aug., 1955). In French.

Air-saturated solutions of ferrous ions in 0.8 N sulphuric acid were exposed to $\beta$-radiation from dissolved $P^{32}$. The number of ferric ions formed per 100 eV energy absorbed was found to be $G_{Fe^{+++}} = 15.4 \pm 0.8$. It is also suggested that the accepted value for W, the energy required for the formation of an ion pair in air, should be increased from 32.5 eV to 34.5 $\pm$ 0.5 eV. A detailed review of the literatur on $G_{Fe}$ includes the effects of radiations of different L.E.T. For Pt II, see Trans. Faraday Soc., Vol. 50, No. 7, 690-710 (1954). M.Ebert

541.15

5494. THE ACCELERATING OR INHIBITING EFFECTS OF HYDROCARBONS IN AQUEOUS SOLUTION ON THE OXIDATION OF $FeSO_4$ BY IONIZING RADIATIONS. I. C.Vermeil.
J. Chim. phys., Vol. 52, No. 7-8, 587-94 (July-Aug., 1955). In French.

The effects of the following hydrocarbons on the X- or $\gamma$-ray yield of $Fe^{+++}$ ions have been examined: saturated straight-chain molecules with 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17 and 18 carbon atoms; saturated branched-chain molecules: isopentane, isohexane, dimethylbutane; saturated cyclic molecules: cyclopentane, methylcyclopentane; aromatic molecules: toluene, o-xylene, ethylbenzene, isopropylbenzene, secondary butylbenzene, tertiary butylbenzene. All reactions studied were dependent on dose-rate, initial $Fe^{++}$ ion concentration, total dose absorbed and, very markedly, on oxygen. The mixture with cyclohexane was also studied under alpha-radiation. M.Ebert

541.15

5495. THE ACTION OF IONIZING RADIATIONS ON AQUEOUS OXALIC ACID. I.Draganic.
J. Chim. phys., Vol. 52, No. 7-8, 595-9 (July-Aug., 1955). In French.

Aerated aqueous oxalic acid solutions 50 mM/l - 700 mM/l were exposed to $Co^{60}$ and to mixed pile radiation. Calculations were based on the Fricke dosemeter, using a $G_{Fe^{+++}} = 15.6$. The values observed with $Co^{60}$ radiation were $G(-H_2C_2O_4) = 4.9 \pm 0.4$ and with mixed pile radiation $G(-H_2C_2O_4) = 5.2 \pm 0.5$. Uranyl oxalate exposed to pile radiation gave the same results. M.Ebert

541.15

5496. A PARTIAL STUDY OF THE DECOMPOSITION BY RADIOLYSIS OF MONOALKYL PHOSPHATES IN AQUEOUS SOLUTION. R.W.Wilkinson and T.F.Williams.
J. Chim. phys., Vol. 52, No. 7-8, 600-15 (July-Aug., 1955). In French.

1 MeV electrons and $Co^{60}$ $\gamma$-radiation were used. Hydrogen peroxide and an aldehyde are formed on irradiation of acyl phosphates. A reaction scheme is proposed for the decomposition of methyl and ethyl phosphate esters. With increasing chain-length of the irradiated molecule the yield of inorganic phosphate remains constant up to amyl derivatives, while the yield of acyl phosphate drops. A slow after-effect liberating inorganic phosphate was observed for n-propyl, n-butyl and n-amyl phosphates. Hydroperoxides were observed in the case of n-propyl phosphate. If irradiation is carried out in the absence of $O_2$, the results become less reproducible, and no after-effect occurs. M.Ebert

541.15

5497. THE RADIATION CHEMICAL POLYMERIZATION OF ACRYLONITRILE IN SOLUTION AND THE SPATIAL DISTRIBUTION OF PRIMARY ACTIVE CENTRES. R.Bensasson and A.Prevot-Bernas.
J. Chim. phys., Vol. 53, No. 1, 93-5 (Jan., 1956). In French.

Pure acrylonitrile forms an insoluble polymer on exposure to X- or $\gamma$-radiation. The velocity V of polymerization was earlier estimated to be $V = KI \exp. 7.6 - 7.9$, where K is a constant and I the intensity of the radiation. Pure acrylonitrile or acrylonitrile + 7M% of water gave very nearly the same intensity exponent (0.73). This constancy suggests that conditions of precipitation do not influence the exponent in this range. Acrylonitrile + 99.2M% of water gave an exponent of 0.85. On addition of 70% of dimethylformamide, a solvent for polyacrylamide, the exponent dropped to 0.55. Results allowed two conclusions:- (1) the primary radiation-produced free radicals which initiate the polymerization are homogeneously distributed throughout the solution; (2) the lifetime of the growing polymer chains is of the order of 100 seconds, i.e. very much longer than the lifetime of the primary free radicals. M.Ebert

541.15

5498. INFRARED SPECTRUM OF ELECTRON-IRRADIATED POLYETHYLENE FOILS. A.Brockes and R.Kaiser.
Naturwissenschaften, Vol. 43, No. 3, 53 (1956). In German.

Spectra for different electron-beam intensities show the gradual formation of an "amorphous" polyethylene, cross-linking, double bonds, and OH and CO groups. W.Good

## DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.18.04

5499. NEW FORMULAE FOR SEDIMENTATION. J.M.Duncyer.
J. Chim. phys., Vol. 53, No. 4, 352-8 (April, 1956). In French.

Formulae are derived for all kinds of sedimentation of solid particles in a liquid due to gravity, or of the separation of solids and liquids in a centrifuge or an ultracentrifuge, or of the fall of small solid particles in a gaseous atmosphere. Laminar and turbulent flow of spherical particles are studied and expressed in their functional relation to number of grains and to mass of the particles. Then actual particles are taken into consideration and Weddel's coefficient of sphericity is used, defined as the ratio between the surface of a sphere having the same volume as the particle to the actual surface of the particle. Diffusion due to Brownian movement has been neglected. Experimental verification of the formulae has not been accomplished yet, but is promised in a later publication R.Neumann

541.182.2/.3

5500. CLOUD CHAMBER FOR COUNTING NUCLEI IN AEROSOLS. B.G.Saunders.
Rev. sci. Instrum., Vol. 27, No. 5, 273-7 (May, 1956).

A cloud chamber is described which measures either the absolute or relative concentration of nuclei in an aerosol. Water droplets are condensed on aerosol particles in a small sample, and the resulting water droplets are photographed on 16 mm film by flashtube illumination and then counted in a microprint reader. Two types of expansion cloud-chambers were found to work satisfactorily, the volume-defined and the pressure-defined. The apparatus is completely automatic and will operate continuously on a one-minute cycle. It can measure aerosol concentrations that range from 200 particles/$cm^3$ to $2 \times 10^6$ particles/$cm^3$. A

541.18

5501. SURFACE DIFFUSION OF HYDROGEN AND OXYGEN ON TUNGSTEN. R.Wortman, R.Gomer and R.Lundy.
J. chem. Phys., Vol. 24, No. 1, 161-2 (Jan., 1956).

When one monolayer of hydrogen or oxygen is deposited on the covered portion of a (011) oriented tungsten tip, migration sets in at 205° K with hydrogen and at 500° K with oxygen. The changes as observed with slow motion cinematographic photographs are described and a mechanism is suggested to account for the observations. It is concluded that two types of surface heterogeneity are active in decreasing heats of adsorption with increasing coverage on metal surfaces, (1) crystallographic anisotropy, (2) the existence of inherently different adsorption sites on a given face. J.Ibal

541.18

5502. ADSORPTION OF METHYLENE BLUE ON A POSITIVELY CHARGED MERCURY SURFACE. J.M.Los and C.K.Tompkins.
J. chem. Phys., Vol. 24, No. 3, 630 (March, 1956).

The apparatus in which the adsorption is measured is described. Surface excess concentration as a function of (bulk) concentration is determined. The area occupied by one methylene blue molecule is found to be 130 $A^2$. W.Good

541.183.26

5503. ADSORPTION AND PHOTOEXCITED ADSORPTION ON ZINC SULFIDE. A.Kobayashi and S.Kawaji.
J. chem. Phys., Vol. 24, No. 4, 907-8 (April, 1956).

The ZnS was a phosphor activated with Cu and it was illuminated in the fundamental absorption band of the crystal (3650 A). The specific surface was 0.3 $m^2g^{-1}$ and the initial heat of adsorption (calc. from the adsorption isotherms at 50° and 100°) was $\Delta H = 8$ kcal; $\Delta H$ was, as expected, equal to the maximum change of the work function (calc. from contact potentials) with adsorption. The adsorption was enhanced by heating in vacuo, more at 100° than at 50°. The photo-excited adsorption is attributed to two factors (a) an increase of reversible adsorption capacity due to pair creation and (b) irreversible photochemical reaction between adsorbed oxygen and defects in the crystal. S.J.Gregg

## CHEMICAL STRUCTURE 541.2/.6

541.5 : 542.934

5504. HYDRATION OF IONS AND CO-ORDINATE BOND. I.Oshida and O.Horiguchi.
J. Phys. Soc. Japan, Vol. 11, No. 3, 330-1 (March, 1956).

Heats of hydration have been determined for about 70 ions from recent thermochemical data. Their values show a general trend downwards with increasing ionic radius and a parallelism with electronegativities. The conclusion is drawn that the formation of co-ordinate bonds plays an important role in the hydration. W.Good

541.64

505. ON THE DEGRADATION OF BRANCHED CHAIN OLECULES. R.Simha.
. chem. Phys., Vol. 24, No. 4, 796-802 (April, 1956).
A procedure for the derivation of the molecular weight istribution in a degrading branched polymer is developed. In ne explicit calculations only sizes up to about twice the dis- ance between branch points are considered. This is adequate o describe the rates of volatilization in the pyrolysis of poly- thylenes. Expressions are given for an arbitrary distribution f branch lengths. If the rate of bond scission is uniform, the ver-all rate is reduced in comparison with the linear case; he branches, if short, have a protective effect. The differ- nces between C-H linkages on tertiary and secondary C's everse the situation. However, the reaction pattern remains nchanged. The rates exhibit maxima which are only insignifi- antly displaced by the presence of (short) branches. Unless he reaction mechanism treated is profoundly altered or the ifferences between two types of bonds are much larger than n small molecules, the existence of branches, per se, does ot account for the observed differences in the kinetics of pyro- ysis of polyethylene and the linear polymethylene. A.

541.64 : 539.379

506. EFFECT OF ELONGATION ON THE PROTON MAG- ETIC RESONANCE OF NATURAL RUBBER. K.Oshima and K.Kusumoto.
. chem. Phys., Vol. 24, No. 4, 913 (April, 1956).
The proton resonance spectrum of unstretched rubber hows a line broadening transition from −38 to-52°C with a ow temperature second moment of 18.5 gauss$^2$. If extended o 500% the range is −30 to-45°C and the second moment 0.3 gauss$^2$. D.H.Whiffen

541.67

507. CALCULATION OF THE MAGNETIC SUSCEPTIBIL- TY OF ACETYLENIC HYDROCARBONS. J.Tillieu and J.Guy.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1436-8 (March 12, 1956). In French.
See also Abstr. 774 (1956). Values calculated using a molecular orbital technique are compared with results obtained by experiment and by other theoretical methods.
G.I.W.Llewelyn

541.67

508. CALCULATION OF THE MAGNETIC SUSCEPTIBI- LITY OF ETHYLENIC HYDROCARBONS. J.Tillieu and J.Guy.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1279-81 (March 5, 956). In French.
See Abstr. 774 (1956). A molecular orbital method for alculation of the diamagnetic susceptibilities of unsaturated ydrocarbons is described. The values obtained for several thylenic hydrocarbons are compared with those obtained by xperiment and by other theoretical techniques.
G.I.W.Llewelyn



545.822

5509. DETERMINATION OF CALCIUM IN ALKALI HALIDE CRYSTALS. L.R.Watson and A.B.Scott.
J. chem. Phys., Vol. 24, No. 3, 619-20 (March, 1956).
A method is described for the determination of calcium in the presence of potassium chloride at concentrations as low as 1.3 x $10^{17}$ calcium ions per cm$^3$ of potassium chloride crystal. This involves the formation of a coloured complex of calcium with murexide (ammonium purpurate), from which the calcium concentration can be determined spectrophotometrically. C.E.King

545.824

5510. AN X-RAY ABSORPTIOMETER FOR THE DETERMINATION OF TETRAETHYL LEAD IN PETROL. J.F.Brown and R.J.Weir.
J. sci. Instrum., Vol. 33, No. 6, 222-5 (June, 1956).
A compact X-ray set suitable for routine determination is described. The X-ray tube, a Ferranti type B100, is operated at 25 kV and 200 $\mu$A using a projection television high tension generator, and has a short term X-ray intensity stability of ± 0.3%. The X-ray detector consists of a phosphor and a photomultiplier. This is capable of determining the concentration of tetraethyl lead in petrol over the range 0 to 1.5 ml./l. (0 to 6 ml./Imperial gallon) with an accuracy of ±0.005 ml./l. (±0.02 ml./Imperial gallon). A.

545.827

5511. SEARCH FOR TECHNETIUM-98 BY NEUTRON ACTIVATION ANALYSIS. E.Anders, R.N.Sen Sarma and P.H.Kato.
J. chem. Phys., Vol. 24, No. 3, 622-3 (March, 1956).
A continuation of earlier work (see Abstr. 9847/1955) and further evidence for the occurrence of $Tc^{98}$ in nature.
M.A.Grace

545.827

5512. UTILIZATION OF THE IONIZATION PRODUCED BY ALPHA RAYS FOR THE MICROANALYSIS OF GASES. M.Lefort.
J. Phys. Radium, Vol. 17, No. 2, 164-5 (Feb., 1956). In French.
The method depends on the fact that for a given pressure the ionization current in an alphatron gauge depends on the nature of the gas. J.Hughes

545.827

5513. DETERMINATION OF $Zr^{95}$ IN FISSION PRODUCT MIXTURES. R.B.Hahn and R.F.Skonieczny.
Nucleonics, Vol. 14, No. 2, 56, 58, 60 (Feb., 1956).
A modification to Hume's procedure for the separation of zirconium is described in detail. Difficulties due to the instability of aqueous cupferron solutions and the bulkiness of the cupferron precipitate are avoided by substituting mandelic acid for cupferron. p-Bromo mandelic acid is not satisfactory as a precipitant. R.D.Smith

# CRYSTALLOGRAPHY 548

548.24

5514. INTERSECTIONS OF {301}, {101} TWIN BANDS IN TIN. S.Maruyama and H.Kiho.
J. Phys. Soc. Japan, Vol. 11, No. 5, 516-21 (May, 1956).
In the course of impact tests on single crystals of $\beta$-Sn, twin bands of the type {301} and its reciprocal {101} were found intersecting each other. The intersections were investigated with a reflecting microscope, and it was observed that crossing twins were accompanied by at least one of the 3 types of additional twinning process: secondary twin, bouncing twin, and broadening or narrowing of the crossed twin. An interpretation of the mechanisms of these additional processes is given, obtained from the results of shear strain measurements around intersections. Several photographs are added, with explanations in detail. A.

548.24 : 548.7

5515. ON THE CORRELATION BETWEEN SCREW DISLOCATIONS AND TWIN STRUCTURE IN $WO_3$ CRYSTAL. T.Nakamura.
J. Phys. Soc. Japan, Vol. 11, No. 4, 467-8 (April, 1956).

Suggests that screw dislocations parallel to [001] may affect the twin structure. Calculation indicates that the stress associated with a screw will not produce a domain detectable by the microscope. To do this, further external stress will be needed. W.Bardsley

548.5

5516. THE GROWTH OF CRYSTALS, A MOLECULAR PHENOMENA. W.Kossel.
J. Phys. Radium, Vol. 17, No. 2, 95-106 (Feb., 1956). In French.

In considering the growth of crystals as a molecular phenomenon, one considers first the primary growth processes, i.e. the deposition of new particles on the crystal. But a crystalline grain can also grow from neighbouring grains. This recrystallization may be illustrated by the Bragg bubble model using a new optical method of observation. In the systematic construction of crystals the tier appears as an independent and essential element. The study of growth phenomena and of dissolution is particularly easy and conclusive if one starts with a single crystal sphere. Interpretation of the figures thus obtained give rise to a simple 'chemical geometry'. It emphasizes the importance of the vicinal faces and the components of the etching medium. Finally the study of electrical current during the growth of silver filaments by electrolysis emphasizes an intermittent crystalline growth which corresponds to the formation of steps of more than a molecular thickness. W.Bardsley

548.5 : 548.736.5

5517. PREPARATION AND STRUCTURE OF THE $CaSO_4$-Mn PHOSPHOR. U.Mayer.
Naturwissenschaften, Vol. 43, No. 4, 79-80 (1956). In German.

Crystals of the phosphor, 3.5 mm in size, are made by evaporating a solution of the constituents in strong sulphuric acid. The crystal structure is identical with that of natural anhydrite. G.F.J.Garlick

548.52 : 532.781

5518. THEORY OF CRYSTAL GROWTH IN UNDERCOOLED PURE LIQUIDS. W.B.Hillig and D.Turnbull.
J. chem. Phys., Vol. 24, No. 4, 914 (April, 1956).

According to simple rate theory the velocity v with which pure crystals grow into their melts at small undercooling $\Delta T$ is $v = D\Delta S\Delta T(lRT)^{-1}$ where D is a diffusion coefficient for transport across the interface, $\Delta S$ the molar entropy of fusion, l the jump distance across the interface and T the temperature, but recent measurements show that $v = A\Delta T^{1.78 \pm 0.08}$ where A is roughly proportional to the fluidity. To reconcile theory with experiment, it is proposed that only a fraction $\alpha$ of the total sites in the crystal surface are available for molecular attachment at a given undercooling, so that $\alpha$ increases approximately as $\Delta T^{0.75}$, and this is explained in terms of a screw dislocation mechanism. The relation $v = 3(\Delta S)^2 D(\Delta T)^2/4\pi V_m RT\sigma$ is derived where $V_m$ is the molar volume and $\sigma$ is the surface free energy, and this agrees with experiment for water, glycerine and salol but not for Sn and P. S.Weintroub

548.52

5519. OBSERVATIONS ON THE PROCESS OF SPIRAL GROWTH IN CRYSTALS OF AMMONIUM DIHYDROGEN PHOSPHATE (ADP). L.Levi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 484-5 (Feb., 1956). In Italian.

Photomicrographs of spirals present on (100) and (010) faces are reproduced and the effect on the sharpness of the spirals of the amounts of impurities present in the solution from which the crystals are grown is discussed. S.Weintroub

548.52 : 536.422.1

5520. EVAPORATION OF PERFECT CRYSTALS. G.W.Sears.
J. chem. Phys., Vol. 24, No. 4, 868-73 (April, 1956).

Evaporation from a perfect face of a paratoluidine crystal does not occur until a critical undersaturation is reached. The vaporization kinetics may be rationalized by postulating that the evaporation rate is limited by two-dimensional nucleation of monolayer holes. A.

## ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

5521. DEBYE CHARACTERISTIC TEMPERATURE AT 0°K OF CERTAIN CUBIC CRYSTALS. J. de Launay.
J. chem. Phys., Vol. 24, No. 5, 1071 (May, 1956).

An earlier article (Abstr. 621/1955) presented a numerical table which permits an easy calculation of the Debye characteristic temperature at 0°K for cubic metallic elements whose elastic constants exhibit the inequality $c_{12} > c_{44}$. This table has been extended to include some cubic nonmetallic elements whose elastic constants exhibit the inequality $c_{12} < c_{44}$. The new table has been utilized in the calculation of the characteristic temperatures of diamond, Ge and Si from their elastic constants. A.

548.7

5522. VIBRATION SPECTRUM OF GRAPHITE AND BORON NITRIDE. I. THE TWO-DIMENSIONAL SPECTRUM. G.F.Newell.
J. chem. Phys., Vol. 24, No. 5, 1049-60 (May, 1956).

A detailed analysis of the vibrational modes of graphite and boron nitride, which are sufficiently similar to be conveniently considered together, begins here with a study of the effects of interactions only between particles in the same layer of the lamellar structure. The secular equation for any lattice vibration problem can be written as a sum of contributions arising from the interactions between various groups of particles. After describing a system of notation which will eventually be used to describe all types of interactions, that part of the secular equation resulting only from nearest neighbours is derived. The frequencies and the spectral densities of all frequency branches are obtained for a system with only these forces. Because of the existence of some low-frequency branches, it is necessary to also consider second nearest neighbour forces, even though they may be relatively much weaker, in order to obtain a complete realistic description. The frequencies of all modes of the system with both types of forces are then analysed. Part of the spectrum can still be found in closed form; other parts can be found only approximately. This analysis gives a fairly complete description of a 'coarse grain' frequency distribution which can, in principle, be used to describe the thermodynamic behaviour of the system at all but the lowest temperatures where the interactions between layers become significant. The principle limitation on its usefulness is at present due to the sizeable number of as yet unknown parameters necessary to describe the system numerically. A.

548.7

5523. THEORY OF THE LATTICE VIBRATION OF GRAPHITE. A.Yoshimori and Y.Kitano.
J. Phys. Soc. Japan, Vol. 11, No. 4, 352-61 (April, 1956).

A theory of the lattice vibration and specific heat of graphite, which has a typical lamellar structure, is worked out using the Born–von Kármán method. Four types of restoring forces are assumed; the first and second ones are associated with changes in the bond lengths and bond angles of the honeycomb net planes, respectively, the third with change in distance between neighbouring atoms on adjacent net planes, and the fourth with the bending of the net planes. Modes are ob-

ined whose polarizations are parallel and perpendicular to e planes. The former are essentially two-dimensional, but e latter are of more complex characters and play a particur role in the temperature range 45° to 100°K. As the main terest is in this and higher temperature ranges, the shearing rces between neighbouring net planes, which are effective at ich lower temperatures, are neglected. For small wave mbers, the theory naturally reduces to the semi-continuum eory developed by Komatsu and Nagamiya (1951) and Komatsu 955). The calculated specific heat curve is in good agreeent with the one observed by DeSorbo (1954) in the temperare range 45° to 300°K. It is concluded that the discrepancy und by Komatsu at temperatures higher than 60°K between s theoretical values of the specific heat and the observed ues is due to the failure of his semi-continuum treatment. A.

548.7

524. THE VIBRATIONS OF A PERTURBED LATTICE. .J.Elliott.
hil. Mag. (Ser. 8), Vol. 1, No. 3, 298-300 (March, 1956).

The introduction of defects into a lattice destroys the eriodicity and in consequence the normal modes are no longer aves. This is analogous to the behaviour of the electron nergy states of a similar lattice on the band approximation. he solution to the electron problem is shown to be qualitative- applicable to the vibrational problem. Applications of the ethod and a more detailed treatment of the general problem re to be published. W.Bardsley

548.7 : 536.631 : 539.219

525. MOLECULAR ROTATION AND TRANSLATION IN RYSTALS. NUCLEAR MAGNETIC RESONANCE ABSORPION, HEAT CAPACITY, AND ENTROPY OF CRYSTALLINE OLID SOLUTIONS OF 2,2-DIMETHYLBUTANE IN 3-DIMETHYLBUTANE FROM 10°K TO 273°K. J.G.Aston, .Segall and N.Fuschillo.
chem. Phys., Vol. 24, No. 5, 1061-6 (May, 1956).

The nuclear magnetic resonance absorption of solid olutions of 2,2-dimethylbutane (A) and 2,3-dimethylbutane (B) as been studied as a function of composition. The melting ange is clearly marked but the rotational transition is osent. There is a maximum in the melting point diagram t the composition $B_2A_3$. Thermal data have been determined n this complex from 10° K to 265°K from which the zero- oint entropy has been deduced. The heat capacity curve and ero-point entropy of the crystals are those of a glass which ndicates translational freedom in the rotating crystals. A.

548.7

526. THEORETICAL CONSIDERATIONS ON METHODS OF NVESTIGATION OF IONIC STRUCTURES IN THE SPECIAL ASE OF METAL OXIDES. J.P.Robin.
. Phys. Radium, Vol. 16, No. 12, 127S - 128S (Dec., 1955). n French.

The occupation index of a metal oxide can be expressed s i = If(R) in which I is a characteristic of the crystal-lattice nd f(R) a function of the ratio of the ionic radii of metal and xygen. The values of I for a number of metal oxides are given n a table. They indicate that the binding forces vary for toichiometrically equivalent configurations. C.Turner

548.7

527. THE DIRECT OBSERVATION OF DISLOCATION ETS IN ROCK SALT SINGLE CRYSTALS. S.Amelinckx.
hil. Mag. (Ser. 8), Vol. 1, No. 3, 269-90 (March, 1956).

A method for decorating dislocation lines in rocksalt single rystals is described. The method consists in colouring the rystals additively by means of sodium metal. It is found that pecks are formed along the dislocation lines, which are, as a onsequence, visible in ultra microscopic observation. It is nought that the specks are colloidal sodium particles, and an xplanation is given for the decorating mechanism. The method is used for the study of the geometry of dislocations in deformed and annealed single crystals (i.e. polygonized). Hexagonal, square and lozenge shaped networks, as well as sets of parallel lines are found. Deviations from the ideal pattern are discussed from a theoretical point of view and compared with observations. It is found that the density of decorating particles is a function of the orientation of the dislocation line with respect to its Burgers vector. Evidence is found that screw dislocations are not decorated; it is further concluded that the nodes of a network are decorated preferentially. The emergence points of the dislocation lines correspond to the centres of the etchpits produced by the methyl alcohol etch. A.

548.7

5528. ON THE COUPLED DISLOCATIONS ALONG A GRAIN BOUNDARY. Y.Uemura.
J. Phys. Soc. Japan, Vol. 11, No. 5, 479-84 (May, 1956).

By analysing the interesting patterns of the etch-pits due to coupled dislocations along a grain boundary in germanium crystals, direct and quantitative verification of the law of interaction between edge dislocations is obtained. A.

548.7

5529. ON THE ABSORPTION OF LIGHT BY COLOUR-CENTRES IN THE REGION BETWEEN F-BAND AND M-BAND. H.Yagi.
J. Phys. Soc. Japan, Vol. 11, No. 4, 430-3 (April, 1956).

When the absorption coefficient of F-band of coloured alkali-halide crystal is about 2 $cm^{-1}$, six new bands called $R_\alpha$, $R_\beta$, $R_\gamma$, $R_\delta$, $R_\epsilon$ and $R_\zeta$ respectively are observed in the region between F-band and M-band. On the other hand, however, Molnar's R-bands ($R_1$ and $R_2$) are observed when the absorption coefficient of F-band is about 20 $cm^{-1}$. The characteristic properties of these new bands are similar to those of Molnar's R-bands. A.

548.7

5530. X-RAY PHOTOCHEMISTRY AT LOW TEMPERATURES IN KBr CRYSTALS. F.Lüty.
Z. Phys., Vol. 145, No. 2, 249-68 (1956). In German.

An investigation was made of the rate of production and the equilibrium concentration of F-, F'-, and other centres in KBr irradiated with X-rays at temperatures from −250° C to room temperature. A.R.Stokes

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.733

5531. A MONITORED GEIGER-COUNTER X-RAY POWDER DIFFRACTOMETER WITH AUTOMATIC RECORDING. J.W.Hughes and E.R.Pike.
J. sci. Instrum., Vol. 33, No. 5, 204 (May, 1956).

The apparatus records the number of counts at 0.02 deg intervals of $2\theta$ across each line, but automatically moves the counter arm rapidly, without recording, between lines. The counts and the $2\theta$ values are recorded photographically. A.R.Stokes

548.734

5532. IMPROVED METHOD FOR PLOTTING RECIPROCAL LATTICE POINTS. W.G.Martin.
J. appl. Phys., Vol. 27, No. 5, 514-16 (May, 1956).

A chart is presented which saves computational time in analysing diffraction photographs of crystals. The new chart, used with a standard Bernal Chart, facilitates the plotting of reciprocal lattice points from spots which are observed on a single crystal X-ray pattern made with monochromatic radiation. A.

548.734.8

5533. A METHOD OF CORRECTING FOR THE EFFECTS OF EXTINCTION ON THE INTENSITIES OF X-RAYS REFLECTED BY A SINGLE CRYSTAL. L.Gatineau and J.Mering.
C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 2018-21 (April 16, 1956). In French.

The extinction effect can be eliminated by measuring intensities at several wavelengths and extrapolating the log against $\lambda^3$ to zero wavelength. It is shown that this extrapolation is very nearly linear. A.R.Stokes

548.735

5534. DIFFRACTION FROM DISLOCATIONS. T.Suzuki and B.T.M.Willis.
Nature (London), Vol. 177, 712 (April 14, 1956).

The results of calculations on diffraction from an edge dislocation are summarized; they agree with observations made on the Lipson diffractometer, but differ from the conclusions of A.J.C.Wilson (1950). A.R.Stokes

548.735.7

5535. USE OF THE SECOND MOMENT AS A CRITERION OF BREADTH OF DEBYE–SCHERRER LINES. ELIMINATION OF THE INSTRUMENTAL EFFECT. M.Tournarie.
C.R. Acad. Sci. (Paris), Vol. 242, No. 16, 2016-18 (April 16, 1956). In French.

The second moment of the intensity distribution across a Debye-Scherrer line, if it exists, can be used as a measure of breadth, and can be corrected very simply for instrumental effects by making use of its additive properties. But the spectral distribution of the incident X-rays must be limited by a monochromator, otherwise this factor contributes a divergent term to the second moment. A.R.Stokes

548.736.1

5536. ON THE CRYSTAL STRUCTURE OF BLACK PHOSPHOROUS. H.Thiel.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 122-5 (1956). In German.

Debye–Scherrer X-ray powder photographs of black phosphorous reveal 42 diffraction lines which have been identified and indexed. These indicate a rhombic structure and not a rhombohedral one as suggested by some authors. (G.Link & H.Jung: Zeitschrift für anorganische und allegemeine Chemie, Vol. 146, 288-92, 1925). G.F.J.Garlick

548.736.3

5537. THE CRYSTAL STRUCTURE OF STANNOUS SELENIDE SnSe. A.Okazaki and I.Ueda.
J. Phys. Soc. Japan, Vol. 11, No. 4, 470 (April, 1956).

Orthorhombic: a = 4.46, b = 4.19, c = 11.57 A; space-group Pcmn. The (x, z) coordinates of atoms are given as: Sn (0.103, 0.118), Se (0.479, 0.855). The structure is a distorted NaCl type, isomorphous with GeS and SnS. A.R.Stokes

548.736.4

5538. CRYSTAL STRUCTURE OF GADOLINIUM ORTHOFERRITE, $GdFeO_3$. S.Geller.
J. chem. Phys., Vol. 24, No. 6, 1236-9 (June, 1956).

The structure has been determined from single crystal X-ray data. There are four $GdFeO_3$ distorted perovskite units in the orthorhombic cell with lattice constants a = 5.346, b = 5.616, c = 7.668, all ± 0.004 A. The structure is solved on the basis that the most probable space group is $D_{2h}(16)$ – Pbnm. However, although the atomic coordinates lead to very good agreement between calculated and observed reflection amplitudes, there are at least very slight deviations from the centrosymmetric space group because the iron sublattices are imperfectly antiferromagnetic. A.

548.736.

5539. THE DEFORMATIONS OF COMPOUNDS OF RARE EARTH AND TRIVALENT TRANSITION ELEMENTS WITH PEROVSKITE STRUCTURE. F.Bertaut and F.Forrat.
J. Phys. Radium, Vol. 17, No. 2, 129-32 (Feb., 1956). In French.

The compounds ($A_2O_3$·$B_2O_3$) and their solid solutions have a deformed perovskite structure, the deformations being in some cases rhombohedral and in others orthorhombic. The deformations are related to the values of the ionic radii of A and B. E.P.Wohlfarth

548.736.5

5540. ON THE METASTABLE TRANSITION AND THE CRYSTAL STRUCTURE OF AMMONIUM NITRATE (TETRAGONAL MODIFICATION). Y.Shinnaka.
J. Phys. Soc. Japan, Vol. 11, No. 4, 393-6 (April, 1956).

Conditions for the appearance of the metastable transitio (IV) ⇌ (II) were studied by X-ray method and dilatometer method and it was found that when the single crystals of the phase (IV) were formed from the aqueous solution at room temperature the metastable transition was always observed and that in dry ones it often proceeded as a single crystal tra formation without any noticeable change in orientation. The crystal structure of the phase (II) was determined by using a single crystal obtained by single-crystal transformation. It was found that tetragonal modification (II) has also CsCl-like structure, and a hindered rotation of the nitrate groups was proposed. A

548.74 : 518.5

COMPUTING SUMS OF PRODUCTS BY PUNCHED CARD FOR ELECTRON DIFFRACTION CALCULATIONS. See Abstr. 4146

548.7

5541. ON THE ELASTIC SCATTERING OF ELECTRONS OBSERVED IN KIKUCHI PATTERNS. H.Hashimoto, E.Yoda and H.Maeda.
J. Phys. Soc. Japan, Vol. 11, No. 4, 464-5 (April, 1956).

Observation of the electron diffraction patterns from a thin film of molybdenite, using an "electron filter", leads to the conclusion that, although Kikuchi lines arise for the most part from inelastic scattering, the energy loss is negligible o occasion. It is thought that Kikuchi lines are partly due to thermal scattering or elastic scattering at imperfections in the crystal. J.Thewli

548.74

5542. A STUDY OF α-RESORCINOL BY NEUTRON DIFFRACTION. G.E.Bacon and N.A.Curry.
Proc. Roy. Soc. A, Vol. 235, 552-9 (June 19, 1956).

The first study of an aromatic molecule by neutron diffra tion, leading to a Fourier projection of the neutron scattering density in the unit cell, gives a value of 1.08 ± 0.04 A for the length of the C–H bonds which link hydrogen atoms to the benzene ring. The spirals of hydrogen bonds which bind together neighbouring molecules are found to consist of typica "long bonds", with the proton much closer to one oxygen atom than to the other. The O–H distance is 1.02 A, and it appears that the O, H, O atoms are not collinear. A.

548.74

5543. INVESTIGATIONS OF THE STRUCTURE AND STRUCTURE-CHANGES OF THE SULPHIDES AND SELENIDES OF SILVER AND COPPER. A.Boettcher, G.Haase and H. Treupel.
Z. angew. Phys., Vol. 7, No. 10, 478-87 (1955). In German.

Electron-diffraction photographs were recorded on a moving photographic plate so as to show changes of diffractio pattern with time. Photographs are reproduced showing how the structures of the four salts change with changing tempera ture, and the symmetries and lattice constants of the struct- ures are given. A.R.Stoke

# GEOPHYSICS 55

550.341 : 621.542.49

5544. MAGNETIC DELAY LINE FILTERING TECHNIQUES. L.J.Jones, J.A.Morrison, G.P.Sarrafian and L.J.Spieker. Geophysics, Vol. 20, No. 4, 745-65 (Oct., 1955).

Presents a discussion of the delay-line method of filter approximation. Magnetic recording delay-line equipment which permits approximation of a wide variety of linear filtering and correlation operations is described. The fundamental theory of linear operator filtering by delay-line techniques is outlined and some possible applications to processing seismic data are briefly discussed. A.

550.341

5545. AN AMPLITUDE STUDY ON A SEISMIC MODEL. C.S.Clay and H.McNeil. Geophysics, Vol. 20, No. 4, 766-73 (Oct., 1955).

The measured amplitudes of two seismic events which have travelled through a two layer seismic model are compared with the amplitudes calculated from plane wave reflection and transmission theory. The relative amplitudes of the events, one a dilatational-dilatational and the other a dilatational-to-shear conversion event, are found to be in agreement with calculations based on reflection theory for plane waves, after correction for $1/r^2$ divergence. A.

550.341

5546. WAVE PROPAGATION IN A STRATIFIED MEDIUM. G.W.Postma. Geophysics, Vol. 20, No. 4, 780-806 (Oct., 1955).

A periodic structure consisting of alternating plane, parallel, isotropic, and homogeneous elastic layers can be replaced by a homogeneous, transversely isotropic material as far as its gross-scale elastic behaviour is concerned. The five elastic moduli of the equivalent transversely isotropic medium are accordingly expressed in terms of the elastic properties and the ratio of the thicknesses of the individual isotropic layers. Imposing the condition that the Lamé constants in the isotropic layers are positive, a number of inequalities are derived, showing limitations of the values the five elastic constants of the anisotropic medium can assume. The wave equation is derived from the stress-strain relations and the equation of motion. It is shown that there are in general three characteristic velocities, all functions of the direction of the propagation. A graphical procedure is given for the derivation of these characteristic velocities from the five elastic moduli and the average density of the medium. A few numerical examples are presented in which the graphical procedure is applied. Examples are given of cases which are likely to be encountered in nature, as well as of cases which emphasize the peculiarities which may occur for a physically possible, but less likely, choice of properties of the constituent isotropic layers. The concept of a wave surface is briefly discussed. It is indicated that one branch of a wave surface may have cusps. Finally, a few remarks are made on the possible application of this theory to actual field problems. A.

550.93

5547. U.S. GEOLOGICAL SURVEY RADIOCARBON DATES. III. M.Rubin and H.E.Suess. Science, Vol. 123, 442-8 (March 16, 1956).

A continuation of detailed reports on the dating of geological and archeological samples at the U.S. Geological Survey radiocarbon laboratory. For Pt I, see Abstr. 1379 (1955). R.A.Newing

## ATMOSPHERE. METEOROLOGY 551.5

551.510.4

5548. OZONE IN THE LOS ANGELES ATMOSPHERE. N.A.Renzetti. J. chem. Phys., Vol. 24, No. 4, 909 (April, 1956).

The presence of $O_3$ in an urban atmosphere during periods of intense "smog" conditions has been confirmed by u.v. spectrography over a 300 ft light-path at wavelengths, 2650, 2800 and 3130 A. D.R.Barber

551.510.4

5549. INFRARED EVIDENCE FOR THE PRESENCE OF OZONE IN THE LOWER ATMOSPHERE. D.E.Burch. J. Opt. Soc. Amer., Vol. 46, No. 5, 360-1 (May, 1956).

Quantitative results obtained with an i.r. spectrograph suggest that $O_3$ exists at altitudes below 9000 ft in amounts quite measurable by modern i.r. techniques, in addition to existing u.v. methods. D.R.Barber

551.510.42 : 551.513

5550. DISPERSAL OF DUST PARTICLES FROM ELEVATED SOURCES. G.T.Csanady. Austral. J. Phys., Vol. 8, No. 4, 545-50 (Dec., 1955).

The equations of Sutton for the atmospheric diffusion of gaseous pollutants are extended to the case of particles of appreciable free falling velocity with the boundary condition that dust fall rate equals ground-level concentration times free-falling velocity. It is shown that the effect of gravitational settling can be allowed for by (a) substituting the height above ground of the downward deflected plume axis for chimney height and (b) by introducing a factor $\alpha(x, z)$ as a multiplier to the "reflection" term in Sutton's equation. A.

551.510.535

5551. MOVEMENT OF SPORADIC E IONIZATION. J.A.Harvey. Austral. J. Phys., Vol. 8, No. 4, 523-34 (Dec., 1955).

The horizontal movement of patches of day-time sporadic E ionization has been observed by using a system of spaced pulse transmitters and a central recorder. The directions of movement are mainly towards the north and west, with speeds mainly between 40 and 80 m/sec. These velocities differ in direction from the F-region disturbances recorded at the same time and have only about half the speed. A.

551.510.535

5552. ELECTRON PRODUCTION AND RECOMBINATION IN THE E-LAYER. C.M.Minnis. J. atmos. terrest. Phys., Vol. 7, No. 3, 172 (Sept., 1955).

Correction to Minnis (Abstr. 4229/1955) which reinforces the conclusion that $\alpha'$ is unlikely to be as high as $10^{-7}$ $cm^3.sec^{-1}$. G.M.Brown

551.510.535 : 621.396.11

5553. ON THE VARIATION OF IONOSPHERIC ABSORPTION AT DIFFERENT STATIONS. W.R.Piggott. J. atmos. terrest. Phys., Vol. 7, No. 4-5, 244-6 (Oct., 1955).

The possibility that the day-to-day changes in absorption at Slough, Swansea and Freiburg are identical is examined statistically. After allowing for known sources of error, it is considered that the residual differences in summer months are too small to be significant, but that it is probable that real differences occur in winter. In both cases the minimum

probable correlation for the Swansea–Slough comparison is very high — about 0.92. A.

551.510.535

5554. THE DETECTION OF THE $S_q$ CURRENT SYSTEM IN IONOSPHERIC RADIO SOUNDING. E.V.Appleton, A.J.Lyon and A.G.Pritchard.
J. atmos. terrest. Phys., Vol. 7, No. 4-5, 292-5 (Oct., 1955).

Determinations of the effective recombination coefficient $\alpha'$ of the E-layer from measurements of the diurnal variation of $N_m$ (maximum electron density) indicate large apparent variations which cannot be admitted for the natural recombination coefficient. The latitudinal variation of $\Delta t$ (delay of $N_m$ on noon) for June shows a phase reversal between high and low latitudes, and it is suggested that, at least in the northern hemisphere, this is evidence for the perturbation of the E-layer by the influences of vertical transport associated with the overhead $S_q$ current system. Moreover, the variations of $\alpha'$ with solar zenith distance are not apparent near the latitude of the $S_q$ current focus, where vertical drift effects would be expected to be absent. G.M.Brown

551.510.535 : 551.521.67

5555. SPIRAL PATTERNING OF SOLAR CORPUSCULAR PRECIPITATION. E.R.Hope.
Nature (London), Vol. 177, 571-2 (March 24, 1956).

Comparison of isochrons (loci of simultaneous occurrence) of F-layer blackout distribution in the North American and North Atlantic region (after Agy, Abstr.9414/1954) and of the diurnal maximum of magnetic disturbance in the Arctic region (after Soviet research) show remarkable agreement, from which it is concluded that the two are continuous. The Soviet isochrons may be explained by a diurnally rotating spiral of solar corpuscular precipitation, rotating at a non-uniform rate, which accounts for the apparent 48 hr period of rotation of storm-D ionization round the pole, suggested for the Atlantic sector. G.M.Brown

551.510.535

5556. REGION E AND THE $S_q$ CURRENT SYSTEM. W.J.G.Beynon and G.M.Brown.
Nature (London), Vol. 177, 583-4 (March 24, 1956).

Considering the simplified equilibrium equation $(fE)^n = K.\cos\chi$, where $\chi$ is the solar zenith angle and K is a constant, values of the index n have been determined for the seasonal variation of fE for a wide range of stations. It is shown that, for a given longitude zone, values of n determined for noon exhibit sharp maxima at or near the latitudes of the $S_q$ current systems in both hemispheres and that these maxima disappear for 1500 hr. Moreover, values of n at one station show an asymmetric variation over the day with a maximum near 1100 hr. An explanation can be formulated in terms of the influence of vertical drift of ionization associated with the east-west component of the $S_q$ current system, the latter being a maximum at about 1100 hr with directions reversed on opposite sides of a focus, and approximately zero at 1500 hr. G.M.Brown

551.510.535 : 523.75

5557. IONOSPHERIC EFFECTS PRODUCED BY SOLAR FLARE RADIATION. V.Agy.
Phys. Rev., Vol. 102, No. 3, 917 (May 1, 1956).

Comments on Sedra and Hazzaa (Abstr. 9291/1955). It is pointed out that ultraviolet radiation from solar flares does not generally affect the E and F1 layers, the ionization being produced at a height less than 100 km. The interpretation of the ionospheric record given in the above-mentioned paper is also questioned. G.M.Brown

551.510.535

5558. EFFECTIVE TILTS OF THE IONOSPHERE AT PLACES ABOUT 1000 km APART. H.A.Whale.
Proc. Phys. Soc. B, Vol. 69, Pt 3, 301-10 (March 1, 1956).

A comparison of the bearing and elevation angles of radio waves from two stations situated about 2000 km to the North and to the West of the receiving site yields results which are sometimes consistent with the existence during the daytime of effective ionospheric tilts which are similar at places more than 1000 km apart. These tilts are of the order of half a degree and are in opposite directions during the morning and the afternoon. They may correspond to actual tilts of a uniform ionosphere or be due to horizontal gradients of electron density. The factor relating the tilt angle to the observed bearing deviations was measured experimentally and the effective tilt angle found to be approximately twice the bearing deviation. A.

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.513

5559. SOME OBSERVATIONS OF WIND VELOCITY AUTO-CORRELATIONS IN THE LOWEST LAYERS OF THE ATMOSPHERE. R.J.Taylor.
Austral. J. Phys., Vol. 8, No. 4, 535-44 (Dec., 1955).

From wind velocity observations in the lowest layers of the atmosphere, mean square velocity differences over a time interval at a point fixed in space are derived and their variation with the time interval is considered. The magnitude of these mean square differences is related to the rate of viscous dissipation of energy and to the shearing stress. On the average, fair agreement with predictions from the dimensional arguments of the theory of local isotropy is shown even though the results pertain to eddy sizes outside the inertial subrange as usually defined. A.

551.521.14

5560. INFRARED RADIATION FROM THE WHITE SANDS AT WHITE SANDS NATIONAL MONUMENT, NEW MEXICO. E.E.Bell and L.Eisner.
J. Opt. Soc. Amer., Vol. 46, No. 4, 303-4 (April, 1956).

Measurements were made with a modified Farrand double monochromator with KBr optics covering the range 1.5-25 $\mu$. It records the difference between the radiance from a test source and that from a reference black body at ambient temperature. A comparison was made between spectral radiance of a clear sky and gypsum sand at White Sands. Sky radiation is produced by $H_2O$ vapour in the 6 $\mu$ and 16-20 $\mu$ region, $CO_2$ in 15 $\mu$ region and $O_3$ near 15 $\mu$. Radiation from the sand shows a minimum at a little below 9 $\mu$. Laboratory tests of the sand, nearly pure gypsum, confirmed the minimum for emission spectra and reflectivity was a maximum at 8.75 $\mu$. This minimum is the result of reststrahlen of the sand. The measurements of $O_3$ in the lower atmosphere are not significantly disturbed by the reststrahlen of the sand. R.S.Read

551.578.1

5561. THE STATISTICAL DESIGN OF AN EXPERIMENT TO TEST THE STIMULATION OF RAIN. P.A.P.Moran.
Austral. J. Phys., Vol. 8, No. 4, 440-8 (Dec., 1955).

The problem of analysing statistically the results of a C.S.I.R.O. rainfall experiment over the catchment area of the Kiewa river is considered. It is shown that in order to obtain a significant result with any reasonable supposed increase in the rainfall within a few years it is necessary to use a control variable strongly correlated with the test variate. The powers of various tests using either streamflow or rainfall as test variates are calculated when the control variable is either streamflow in the Murray or rainfall in other areas. The general problem of designing such tests and the relationship between rainfall and streamflow are also considered. A.

551.578.1

5562. ARTIFICIAL ICE-FORMING NUCLEI. B.J.Mason and J.Hallett.
Nature (London), Vol. 177, 681-3 (April 14, 1956).

Tests on many chemicals for their action as nuclei showed hat inconsistency in the results of different workers was due o trace contaminants in the air, especially Ag and I, and to race impurities in the chemical tested. When these are spec-roscopically pure and all traces of Ag and I are excluded from he air in the experimental chamber the great majority of sub-tances reported as active by other workers fail to produce ice rystals in a supercooled cloud at temperatures above $-40^0$ C, hen spontaneous nucleation of supercooled drops occurs. The nly chemical compounds found to be definitely active as ice-form-ng nuclei at temperatures above $-40^0$ C were AgI ($-5^0$ C), PbI ($-7^0$C) nd $HgCl_2$ ($-25^0$ C), the temperatures in brackets indicating thresh-ld limits of activity. The efficiency of AgI depends very much pon its method of preparation. When vaporized at high tem-eratures a mixture of cubic and hexagonal crystals results, ut which is the more efficient for ice nuclei is not known. At igh temperatures metallic Ag may form on the crystal sur-ace and the ice-forming ability is decreased. Irradiation by trong sunshine also has this effect and the AgI quickly loses ts ice-nucleating property. R.S.Read

551.593.5

5563. INFRARED TRANSMISSION OF SYNTHETIC ATMOS-PHERES. II. ABSORPTION BY CARBON DIOXIDE. J.N.Howard, D.E.Burch and D.Williams. J. Opt. Soc. Amer., Vol. 46, No. 4, 237-41 (April, 1956).

For Pt I, see Abstr. 3391 (1956). The total absorption $\int A_\nu d\nu$ has been determined for the $CO_2$ bands at 15, 5.2, 4.8, 4.3, 2.7, 2.0, 1.6 and 1.4$\mu$ under simulated atmospheric conditions. The absorber concentrations w ranged from 1 to 1000 atm cm of $CO_2$ for the strong bands and from 100 to 3600 atm cm for the weak bands. Nitrogen was added to give total pressures ranging up to atmospheric; the pressure effects of oxygen were found to be similar to those of nitrogen. The observed data can be satisfactorily represented by two types of empirical relations.

(1) For small values of total absorption,

$$\int A_\nu d\nu = cw^{\frac{1}{2}}(P + p)^k;$$

(2) For large values of total absorption,

$$\int A_\nu d\nu = C + D \log w + K \log(P + p),$$

where w is the $CO_2$ absorber concentration, p is the $CO_2$ partial pressure, and P is the total pressure. Values of the constants c, k, C, D and K are given for each region of characteristic absorption. The present results are compared with those obtained in earlier studies. The use of the empirical relations in calculating atmospheric absorption is discussed. A.

551.593.5

5564. INFRARED TRANSMISSION OF SYNTHETIC ATMOSPHERES. III. ABSORPTION BY WATER VAPOR. J.N.Howard, D.E.Burch and D.Williams. J. Opt. Soc. Amer., Vol. 46, No. 4, 242-5 (April, 1956).

The total absorption $\int A_\nu d\nu$ has been measured for the water vapour bands at 6.3, 3.2, 2.7, 1.87, 1.38, 1.1 and 0.94$\mu$ under simulated atmospheric conditions. The water vapour absorber concentrations studied ranged from 0.004 to 3.8 cm of precipitable water. Nitrogen was added to give total pressures up to atmospheric; the effects of nitrogen and oxygen on total absorption were found to be similar. The experimental data can be satisfactorily represented by two types of empirical relations:

(1) For small values of total absorption,

$$\int A_\nu d\nu = cw^{\frac{1}{2}}(P + p)^k;$$

(2) For large values of total absorption,

$$\int A_\nu d\nu = C + D \log w + K \log(P + p),$$

where w is the $H_2O$ absorber concentration, p is the $H_2O$ partial pressure, and P is the total pressure. Values of the empirically determined constants c, k, C, D and K are given for each of the spectral regions of characteristic absorption. The results are compared with those of other experimentalists. A.

551.593.5

5565. INFRARED TRANSMISSION OF SYNTHETIC ATMOSPHERES. IV. APPLICATION OF THEORETICAL BAND MODELS. J.N.Howard, D.E.Burch and D.Williams. J. Opt. Soc. Amer., Vol. 46, No. 5, 334-8 (May, 1956).

Two types of theoretical models for an absorption band are described and applied to infrared absorption bands of $CO_2$ and $H_2O$. For $CO_2$, which has a regular fine structure, the so-called Elsasser model, which assumes equally-spaced, equally-intense lines, can be applied. For $H_2O$, which has a highly irregular fine structure, the so-called statistical or Goody model, which assumes random spacings and intensity distribution, is applicable. The individual lines are assumed to have the Lorentz shape in both models. The method of application of these models to the experimentally observed bands is discussed in detail. A.

551.594.221 : 550.384

5566. MAGNETIC FIELD VARIATIONS FROM LIGHTNING STROKES IN VICINITY OF THUNDERSTORMS. H.Norinder. Ark. Geofys., Vol. 2, Paper 20, 423-51 (1955).

A preliminary examination is presented of about 2300 oscillograms produced by lightning strokes within about 20 km of three recording stations. Simultaneous records are obtained from vertical and horizontal frame aerials and the results produced by these are compared. Two time scales are used, viz. 100$\mu$sec and 5 msec, the latter serving to record slow pre-discharge processes. Statistical results are given of the polarity of the discharges; times to front and half values; duration of superimposed oscillations; number of successive discharges; and variation of field intensity with distance of stroke. R.H.Golde

551.594.6

5567. LOW AUDIO-FREQUENCY ELECTROMAGNETIC SIGNALS OF NATURAL ORIGIN. R.E.Holzer and O.E.Deal. Nature (London), Vol. 177, 536-7 (March 17, 1956).

The mean diurnal variation is plotted of a natural signal within the frequency range 25-130 c/s. A typical difference is shown to exist between the signals received in winter and summer. It is suggested that these signals are due to atmospherics produced in different parts of the world and that the world's entire thunderstorm activity might be recorded by a very few low-frequency stations. R.H.Golde

551.594.6

5568. ON THE INTERPRETATION OF THE ATMOSPHERICS PRODUCED BY LIGHTNING DISCHARGES. W.O.Schumann. Z. angew. Phys., Vol. 8, No. 1, 24-8 (1956). In German.

The wave shapes of atmospherics recorded at night at distances exceeding 2000 km, and at dawn and dusk at shorter distances, have been interpreted (Abstr. 10360/1954) by the horizontal components of the radiating lightning discharges. A mathematical derivation is given of the fields produced at different distances by vertical and horizontal dipoles and the effects are examined which are exerted in successive reflections by the curvature of the earth's surface and by a limited conductivity of the reflecting layers. It is claimed that the theory outlined is capable of explaining the characteristic wave shapes of the atmospherics recorded during the earlier investigation. R.H.Golde

# BIOLOGY 57/59

578.087.9

5569. AUTOMATIC RESPIRATORY VALVE. J.Clark, A.E.Reif and B.van Ness.
Rev. sci. Instrum., Vol. 27, No. 5, 311-15 (May, 1956).

An electronically controlled respiratory cycling valve is described. This valve was designed for use in aerosol inhalation experiments with humans or dogs and is characterized by a low dead space (27 $cm^3$) and by wide channels for air flow (minimum dimension 1.3 cm). The valve is automatically operated by respiratory pressure changes in the order of 3 mm water. A.

578.088.9

5570. MODELS OF IODINE METABOLISM. M.Berger and R.Moret.
J. Phys. Radium, Vol. 16, No. 12, S 128 - S 129 (Dec., 1955). In French.

In order to investigate the metabolism of iodine in the body measurements have to be made at regular intervals after introduction of a dose of radioactive $I^{131}$ of the quantity of $I^{131}$ deposited in the thyroid gland and excreted in the urine and concentration in inorganic and organic compounds in the plasma. Concentration of stable I may also be measured. Evaluation of measurements is involved, as the process depends on diffusion through membranes and chemical reactions and is represented by a system of linear differential equations of the first order. It is preferable to use models, either hydrodynamical with a coloured liquid (the solvent representing the stable I, the coloured solvate the $I^{131}$), or electrical, the compartments being replaced by condensers and the specific radioactivities by voltages, which may be shown on a c.r.-tube. No details of either method are given; there are references of relevant publications. V.Quittner

## MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.843

5571. STUDY OF THE DISTRIBUTION OF LIGHT IN THE RETINAL IMAGE OF A SLIT. F.Flamant.
Rev. Opt., Vol. 34, No. 9, 433-59 (Sept., 1955). In French.

This remarkable paper gives an account of a subjective and an objective method of determining the above function. In the former, the apparent size of a point image is measured as a function of luminance and pupillary diameter d ($0.22 \leq d \leq 1.04$ mm). Owing to the variation of the visual threshold with eccentricity this method failed to yield the desired result. In the objective arrangement a neutral density wedge ( D = 0 to D = 3) was placed along a slit, illuminated with white light, the lines of equal density being at right angles to the slit. The resulting retinal image was photographed with exposures ranging from 5 to 20 minutes. Owing to the graininess of the plates (Kodak XX), it was necessary to superimpose ten photographs and to analyse the resulting image, which was good. The light distribution was evaluated by Fourier analysis, and the resulting data compared with others obtained subjectively by other workers. Derived functions for visual acuity and contrast threshold are also compared with subjective results obtained by previous workers. 12 tables, 18 refs. 30 figs. R.A.Weale

612.843.3

5572. FLICKER AND COLOR ADAPTATION IN THE HUMAN ELECTRORETINOGRAM. J.C.Armington and W.R.Biersdorf.
J. Opt. Soc. Amer., Vol.46, No. 6, 393-400 (June, 1956).

Flickering ten millisecond light stimuli have been used to elicit the human electroretinogram under conditions of chromatic adaptation. The resulting records have been examined both for participation of photopic and scotopic mechanisms, and for selective wavelength effects. With slowly flickering stimuli (4 flashes per second) the ERG (electroretinogram) exhibited distinct photopic and sctopic components even when recorded from eyes that were well light adapted. More rapidly flickering stimuli (20 flashes per second) elicited pre-eminently photopic potentials. It was found that the adaptation stimuli, depending upon their colour, were effective in reducing the sensitivity of one or the other component, but that specific chromatic effects within either component were quite small. The results are discussed in relation to psychophysical data and earlier ERG experimentation. A.

612.843.31

5573. SOME QUANTITATIVE ASPECTS OF AN OPPONENT COLORS THEORY. III. CHANGES IN BRIGHTNESS, SATURATION, AND HUE WITH CHROMATIC ADAPTATION.
D.Jameson and L.M.Hurvich.
J. Opt. Soc. Amer., Vol. 46, No. 6, 405-15 (June, 1956).

For Pt II see Abstr. 9315 (1955). A theoretical model for an opponent-colours theory of vision is used to predict and describe quantitatively changes in the brightness, saturation, and hue of colours with changes in chromatic adaptation. The systematic nature of such changes in colour appearance is examined, and comparisons are made between specific theoretical predictions and results of experimental studies of chromatic adaptation. A.

612.843.31 : 535.64

5574. SOME QUANTITATIVE ASPECTS OF AN OPPONENT-COLORS THEORY. IV. A PSYCHOLOGICAL COLOR SPECIFICATION SYSTEM. L.M.Hurvich and D.Jameson.
J. Opt. Soc. Amer., Vol. 46, No. 6, 416-21 (June, 1956).

A system for the numerical specification of colours is developed on the basis of a quantified opponent-colours theory. The derived HBS (hue, brightness, and saturation) system permits the quantitative specification of colours in terms of their primary psychological (perceptual) attributes for various adaptations and illuminations. A.

612.843.31

5575. COLOUR ILLUSIONS AND ABERRATIONS DURING STIMULATION BY FLICKERING LIGHT. W.Grey Walter.
Nature (London), Vol. 177, 710 (April 14, 1956).

Normal observers were shown Ishihara tables in intermittent illumination (peak illumination 80000 f.c.; duration 20 $\mu$sec; colour bluish/white) at flashing rates varying from 1 to 20 per sec. Responses typical of colour-defective observers were elicited, their nature depending on the observer and the flashing rate. R.A.Weale

612.843.32

5576. A WAVELENGTH DISCRIMINATION SPECTROMETER. C.R.Forshaw.
J. sci. Instrum., Vol. 33, No. 6, 217-22 (June, 1956).

An improved instrument is described, in which arrangements are made for viewing a bipartite field illuminated by lights of desired wavelengths and luminances. The instrument is essentially a prism spectrometer with a double collimator, and produces spectra of high dispersion and intensity. With an artificial pupil of only 1 mm diameter, retinal illuminations of 100 photons (or trolands) can be obtained at wavelengths of 420 m$\mu$ and 690 m$\mu$. Some preliminary results of wavelength discrimination measurements are given to illustrate the performance of the spectrometer. A.

612.843.611

577. STUDIES ON DARK ADAPTATION. II. THE PRE-XPOSURE TOLERANCE OF THE HUMAN FOVEA ADAPTED O DIFFERENT BRIGHTNESS LEVELS. D.E.Johannsen, I.McBride and J.W.Wulfeck.
Opt. Soc. Amer., Vol. 46, No. 4, 266-9 (April, 1956).

For Pt I, see Abstr. 854 (1956). The effect on foveal dark laptation of pre-exposure of the eye for brief durations to ght of relatively low brightnesses was investigated after the e was adapted to different levels of brightness. Monocular easurements of absolute brightness sensitivity were made sing a square, one degree on a side, centrally fixated, test itch. The course of dark adaptation as measured by the RL as investigated following ten minutes exposure to each of ree adaptation levels, 0.10, 1.0 and 10. ft-L. In addition, e effect of superimposing certain combinations of pre-expo- ire brightness (100., 10., and 1.0 ft-L) and durations (100, ), and 1 sec) upon each of the adaptation levels was inves- gated. The effect of increasing adaptation level, in the ab- ence of pre-exposure, was to increase the loss of sensitivity, nd hence the extent of subsequent dark adaptation. The effects f superimposing various pre-exposures upon the different daptation levels were found to be complex. With two excep- ons, the only instances in which pre-exposure superimposed pon adaptation level produces more subsequent adaptation han adaptation level alone occurred when the product of pre- xposure brightness and duration exceeded 100 ft-L-seconds. ccasional combinations of pre-exposure brightness and uration superimposed upon an adaptation level appeared to roduce no subsequent adaptation which could be measured vith the apparatus and technique used. A.

612.843.63

578. PSYCHOLOGICAL EFFECTS ON OBSERVATIONS XTENDING IN TIME. L.Ronchi and M.T.Zoli.
tti. Fond. Ronchi, Vol. 10, No. 5, 356-70 (Sept.-Oct., 1955). n Italian.

The resolving power of the eye was examined with retinal mages derived from external virtual and real images in turn. nterference fringes of different spacing were observed in the ormer case during a period of 2 min when the observer re- corded the degree of resolution achieved. There were marked — and sometimes systematic — fluctuations. The fluctuations vere more pronounced with the real image. Possible reasons or the observed effects are discussed, eye-movements ccupying an important position in the argument. R.A.Weale

612.843.63

579. MEASUREMENT OF VISUAL ACUITY WITH MOVING MAGES. A.Fiorentini.
Atti Fond. Ronchi, Vol. 10, No. 6, 452-67 (Nov.-Dec., 1955). n Italian.

This interesting paper describes a method with which visual acuity (V.A.) was measured as a function of frequency and amplitude of vibration of a mirror imaging a test grating luminance ~420 nits). The vibration rate of the mirror in- creased in steps of approx 10 c/sec to 144 c/sec. V.A. de- creased rapidly as the frequency rose from 0 to 30 c/sec. For vertical lines, high amplitudes led to more severe deteri- oration than for horizontal ones. The difference between V.A. as measured with moving and stationary images respectively increased to f ~ 20 c/sec and then remained constant. The data are related to types of eye-movement and interpreted in terms of critical fusion frequency. R.A.Weale

612.843.721

5580. ROLE OF CONVERGENCE IN STEREOSCOPIC VISION. I.G.H.Ishak, I.M.H.Hefzalla and Y.K.M.Badawy.
J. Opt. Soc. Amer., Vol. 46, No. 4, 303 (April, 1956).

Wright's method (Abstr. 5950/1951) was modified by testing stereo-acuity A with pairs of test-fields, not exposed simultaneously, but at intervals of 0.3 sec. For an angle of separation of 5°, A was 25% of the value obtained for simultaneous exposure, at 40° the two values were equal. The authors conclude that convergence plays a role in stereoscopic vision. R.A.Weale

612.843.721

5581. ROLE OF CONVERGENCE IN STEREOSCOPIC VISION. K.N.Ogle.
J. Opt. Soc. Amer., Vol. 46, No. 4, 303 (April, 1956).

The above experiment (preceding abstract) is criticized because an interval of 0.3 sec does not give the fixation axes of the eyes enough time to deviate from their original angles, i.e. the stimulus due to disparity of the retinal images has not been eliminated by this method. R.A.Weale

612.844.23

5582. ON THE SUBJECT OF SPHERICAL ABERRATION OF THE EYE. A.Ivanoff.
Optica Acta, Vol. 3, No. 1, 47-8 (1956). In French.

Evidence is presented for the belief that spherical aberration of the human eye can vary with the distance d between the point of pupillary entry of ray of light and the optic axis of the eye when $d < 0.5$ mm. R.A.Weale

612.858.73

5583. INTENSITY OF HARMONIC AND COMBINATION COMPONENTS IN NONLINEAR DISTORTIONS OF OSCILLATIONS OF COMPLEX FORM. V.M.Vol'f.
Akust. Zh., Vol. 1, No. 4, 321-5 (1955). In Russian.

A method is given for evaluating the above and the intensity calculated for these components in the case of nonlinear distortions of triangular, saw-tooth and rectangular oscillations. It is shown that the harmonic may be much the smaller of the two sets of components. The significance of this in the theory of hearing is discussed. C.R.S.Manders

614.892

5584. DEVICES FOR THE PROTECTION OF HEARING FROM THE TRAUMATIC ACTION OF NOISES. I.M.Polkovskiĭ.
Akust. Zh., Vol. 1, No. 3, 249-56 (1955). In Russian.

The basic requirements in devices for the protection of hearing are set out and formulae derived for their calculation. Cases are worked out for the aural plug and ear-muff. C.R.S.Manders

614.892

5585. EAR DEFENDERS: MEASUREMENT METHODS AND COMPARATIVE RESULTS. J.C.Webster.
Noise Control, Vol. 1, No. 5, 34-42 (Sept., 1955).

614.898

5586. HANDLING ALPHA-ACTIVE, PYROPHORIC MATERIALS. I. WHAT IS THE BEST APPROACH? L.R.Kelman, W.D.Wilkinson, A.B.Shuck and R.C.Goertz.
Nucleonics, Vol. 14, No. 3, 61-5 (March, 1956).

A review of hazards and handling techniques with special reference to methods developed at Argonne. A brief description is given of a leak-tight He atmosphere glove-box system, a fuel fabrication system and a remote handling system for irradiated fuel elements. R.D.Smith

614.898 : 621.317.2 : 621.389

5587. THE INSTALLATION OF A FIXED MONITORING SYSTEM IN THE HIGH-ACTIVITY LABORATORIES AT SACLAY. R.Fabre and C.Guyot.
Onde élect., Vol. 35, 938-45 (Oct., 1955). In French.

In each of the 10 individual laboratories, the system continuously monitors both the radiation level and the radioactivity in the air; the first by using ionization chambers and d.c. amplifiers and the second by continuously sampling the air and passing it through a moving filter-paper whose radioactivity is suitably measured. Tolerance levels are fixed for the appropriate working conditions (i.e. part of body exposed, and type of radioactive substance). Pen recorders register

these levels and a system of signal lamps indicates the ranges 0-1, 1-5, >5 times tolerance level. All electronic equipment and recorders are placed in a central control room whence the lamp indications are fed back to the laboratories, and whence also the auxiliary ventilating system is controlled.
L.E.Mussell (R

# TECHNIQUE. MATERIALS 62/69

669 : 548.5

5588. ON THE STABILITY OF FLOATING MOLTEN ZONES. W.Heywang.
Z. Naturforsch., Vol. 11a, No. 3, 238-43 (1956). In German.

The stability of the floating zone in the method of refining invented by Keck and Golay (1953) is analysed in terms of the parameters which affect it, i.e. length, diameter, temperature, and profile. C.A.Hogarth

## PHOTOGRAPHY 77

77.023.4

5589. A SIMPLE DEVELOPMENT PROCEDURE FOR NUCLEAR PLATES. W.Lohmann.
Z. Naturforsch., Vol. 11a, No. 2, 174-5 (1956). In German.

After a brief summary of the current processing methods, results are given on the two-bath method using a constant temperature of 20°C. It is found that certain pH-values of the developer are desirable (between 3 and 6). The pH-values obtained by the addition of certain acid substances to the developer are given and it is found that HC1 is the most suitable acidifying agent. Recommended development times in each bath for different thicknesses of emulsion are given for Agfa-K plates. D.J.Prowse

771.53

5590. FOGGING EFFECT OF PAPERS ON SENSITIVE LAYERS. R.Lochet and M.Biehler.
J. Phys. Radium, Vol. 16, No. 12, 97S-98S (Dec., 1955). In French.

The effect of certain insolated papers on photographic emulsions is due to the chemical effect of oxidation products of resinous materials in the paper, not to any phosphorescence or chemiluminescence. S.T.Henderson

778.3

5591. ELECTRON BACKGROUND IN IMPORTED G5 EMULSIONS. V.D.Hopper and J.E.Laby.
Austral. J. Phys., Vol. 8, No. 4, 557-62 (Dec., 1955).

Estimates have been made of the electron background to be expected from a variety of sources in emulsions imported into Australia. The dose received, due to cosmic radiation while the emulsions are in flight and to radiation on the groun should be of the order of 10 mrep. In some emulsions this background was found. In others however it was much higher and other factors such as radioactive paint on instrument panels in the aircraft have been examined. It appears that there is a correlation between the radioactivity of rain falling in Paris and the high background found in plates shipped on certain days. Isolated clouds of radioactive contaminants resulting from nuclear explosions appear to be responsible for some anomalously high backgrounds. D.J.Prowse

771.36

5592. RAPID-CLOSING ELECTRONICALLY-OPERATED SHUTTER. H.E.Edgerton and F.I.Strabala.
Rev. sci. Instrum., Vol. 27, No. 3, 162 (March, 1956).

A shutter that closes quickly for capping drum cameras i described. A density of 3 is obtained in about 30 μsec by the sudden evaporation of a network grid of small lead wires. Energy for the evaporation and control of the operation instant are accomplished by a charged capacitor and a series hydroge thryatron respectively. A

771.53

5593. HERSCHEL EFFECT IN SILVER CHLORIDE CRYSTALS. R.Meyer.
Naturwissenschaften, Vol. 43, No. 5, 103 (1956). In German.

The disappearance of photolytically separated Ag under red and infrared light has been observed microscopically. The effect can be repeated on the same crystals, photographs of which are given. S.T.Henderson